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to

PERSONNEL-SYSTEMS RESEARCH

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PREVIOUS REPORTS ON THE SUBJECT OF JOB ANALYSIS IN THE MILITARY SERVICES

"Tri-Service Conference on Job Qualifications Analysis," ONR Symposium Report ACR-41, May 1959

"Tri-Service Conference on Staffing Standards," ONR Symposium Report ACR-51, April 1960

"Tri-Service Conference on Selection Research," ONR Symposium Report ACR-60, May 1960

"Tri-Service Conference on the Role of Job Evaluation Techniques in the Structuring of Military Occupations," ONR Symposium Report ACR-71, April 1961

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PREFACE

For the past several years representatives of the Army, Navy, and Air Force have come together periodically to discuss personnel research progress and problems. These invitational meetings, which have emphasized the communication of ideas and information, have been addressed at current issues of mutual concern. They seek to avoid the characteristics of annual reports. Up to the present, each meeting has focused on research dealing with some single aspect of personnel handling. This year the decision was made to take a broader look at personnel handling as a personnel system.

The expression "personnel system" refers to all aspects of personnel handling considered simultaneously. The theme of the meeting emphasized the integrated nature of personnel systems—how almost any personnel action has ramifications for other personnel actions. While this fact is certainly not new, rather little research effort has been exerted over the years toward its formal statement and analysis. However, times do change. Work has been undertaken to illuminate personnel-systems problems, and techniques are being developed for applying the systems approach in the personnel area. The purpose of the meeting reported here was to exchange information about appropriate studies supported by the separate military services in this important research area.

Once again it was the pleasure of the Personnel and Training Branch of the Office of Naval Research to sponsor the tri-service personnel-research meeting. As before, plans and arrangements were capably handled by a committee consisting of service representatives. They were: Harry I. Hadley, Occupational Standards Section, Department of the Army, Personnel Management Group; D. G. Price, Personnel Systems Research Branch, Bureau of Naval Personnel, Department of the Navy; and Lt. Col. E. F. Rodriguez, Directorate of Personnel Planning, Hq., Department of the Air Force. The continuity of this committee has contributed in large measure to the success and the continuity of the series of meetings. Those who have attended the conferences are indebted to the committee for its efforts and leadership.

In addition to the papers reproduced here, Mr. G. C. Lee, Office of the Assistant Secretary of Defense, Department of Defense, discussed a number of current and pending developments in defense manpower planning.

E. J. McCormick, Professor of Psychology, Purdue University, served as a consultant during the conference. His perceptive comments are summarized in the final portion of these proceedings.

Grateful appreciation is expressed to the speakers and to all others who contributed to the success of the 1962 conference.

Glenn L. Bryan

GLENN L. BRYAN
Head, Personnel and Training Branch
Office of Naval Research

PART I
SOME NEW DEVELOPMENTS ON THE NATIONAL SCENE

THE NEW CLASSIFICATION SYSTEM OF THE UNITED STATES EMPLOYMENT SERVICE

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The Dictionary of Occupational Titles (DOT) was published originally in 1939 for use as a placement tool in the United States Employment Service. It included information on about 19,000 occupations. This information was sufficient to identify titles and define them in terms of what work gets done, how it is done, and why it is done. The classification structure which organized the information in the Dictionary was designed primarily for statistical reporting purposes, but it also served the needs of placement very well. However, there was an increasing need for occupational information for vocational guidance purposes. Work was undertaken immediately to supply this information.

In 1944 the Employment Service published Part IV of the Dictionary. This provided a means of classifying individuals, based on information other than work experience. The Part IV classification structure was quite different from the one in Volume II of the 1949 edition, and it related to only about 5,000 of the 19,000 occupations defined in the Dictionary. The Employment Service undertook research to find out how the DOT could integrate guidance-oriented information with placement-oriented information for all jobs in a single structure. The results of this research will be incorporated in the revised, third edition of the Dictionary. The "Estimates of Worker Trait Requirements for 4,000 Jobs," published in 1957, was one interim byproduct of this research. It provided estimates of training time, aptitudes, interest, temperaments, physical capacities, and working conditions. However, it provided this information for only a selected sample of 4,000 jobs from the DOT, and the estimates were based on the job definitions of the 1949 edition of the Dictionary.

The third edition of the Dictionary will go to press during calendar year 1963. Its contents will be completely revised. Jobs in all industries are being reanalyzed. Obsolete jobs are being deleted, and perhaps 6,000 jobs new to the Dictionary will appear. For example, you have heard that the number of professional and technical workers has doubled in recent years. At the same time, the number of occupational specialties in this area has also increased. The new DOT will, therefore, provide expanded coverage of the professional and technical occupations, and the code range allocated to these jobs in the classification structure will be doubled.

The new DOT edition will contain two volumes. Volume I will contain job definitions arranged alphabetically, as at present. Volume II will contain two classification arrangements of job titles: the first will group titles in terms of what gets done—purpose, method, material, product, subject matter, and service; the second will arrange the job titles grouped in terms of worker functions and worker trait requirements. The titles grouped by worker function will reflect the kind of information published in the "Estimates of Worker Trait Requirements for 4,000 Jobs." But the information will be provided for all jobs in the Dictionary, and the

estimates will be based on new job observations rather than on previously published definitions. Volume II provides two arrangements, one primarily for placement and one primarily for counseling, which are really two dimensions of a single classification structure. All jobs will be classified by six-digit code numbers. Each job will have the same code number in both volumes of the Dictionary. The first three digits will reflect such attributes of a job as purpose, method, material, product, subject matter, or service. The last three digits will identify the worker functions and will reflect the worker's involvement with data, people, and things, as well as the worker trait requirements.

What are the implications of the information in the new edition of the Dictionary for guidance? The job definitions of Volume I will include not only what gets done, and how, and why, but also the worker function and worker trait information. Each job definition will include, directly or by implication, information on critical physical demands, working conditions, interests, temperaments, training time, and aptitudes.

The two arrangements of the classification structure of Volume II are illustrated in the Appendix following this paper. There are six categories of the arrangement by work field: (a) Professional, Technical, and Managerial, (b) Clerical, (c) Sales, (d) Service, (e) Farming, Fishery, and Forestry, and (f) Industrial. These categories will be divided into about 90 divisions (represented by the first two digits of the code) based on subject matter, service, purpose, method, material, or product. These 90 divisions can be of use in classifying general vocational goals when goals at the more specific three-digit level cannot be determined. They can also be used as a filing system for job-oriented occupational information. These divisions will be defined, as will the three-digit groups into which they are subdivided. This will be something new in the Dictionary. There will be definitions not only of jobs, but also of the divisions and groups into which related jobs fall. Within each group the jobs will be arranged generally in order of level of complexity, and the worker functions and worker trait patterns will be identified by the last three digits of the code number.

The arrangement of occupations by worker functions is an inversion of the arrangement by work fields. All jobs will be grouped into seven categories to indicate whether the worker's involvement is with data, with people, with things, or with any combination of these. The categories will be divided into about 90 divisions (identified by the last three digits of the code number) based on worker functions and worker trait requirements. These divisions can be of use in classifying counselees on the basis of information about the individual, and they can be used as a filing system for worker or individual-oriented occupational information. As with work field arrangements, these divisions of the worker function arrangement will be defined. Within each group the jobs will be arranged according to the work field groups in which they appear.

The revised Dictionary will include information to satisfy both guidance and placement needs. This information will appear in both volumes and will be cross-referenced in such a way that whether you begin with information about jobs or about individuals there will be a place to enter the system and locate all related information.

APPENDIX

ILLUSTRATION OF THE NEW CLASSIFICATION SYSTEM OF THE UNITED STATES EMPLOYMENT SERVICE

The work field arrangement for the third edition combines those features of the 1949 (Vol. II) structure and of recent occupational research that appear most useful in the placement process.*

Individual classifications are identified by six-digit code numbers. All occupations are grouped into six categories (see p. 6) which, in turn, are divided into smaller groupings at different levels of detail. The distinctions between professional and semiprofessional, and between skilled, semiskilled, and unskilled, do not appear in this structure. Instead, the following principles were followed:

1. Throughout the structure, jobs will be grouped first by some combination of work field, material, product, subject matter, service, generic term, and/or industry. This is reflected in the first three digits of the code: 000.000 (see p. 3).

(This involves no change in our traditional concept of the three-digit group. It is planned only to apply this concept consistently throughout the structure and to reflect its meaning always in the first three digits of the code.)

2. Within each three-digit group, jobs will be grouped according to specific kinds of activities performed and skills and abilities required, and will be arranged generally in descending order of level of complexity. This will be reflected in the last three digits of the code: 000.000. (See p. 4.)

(This will permit designation of levels and kinds of skills without limiting them to exactly two or three possible levels and without the stigma of allocation to categories labelled "semi" professional or "un" skilled.)

PRINCIPLE 1

Where the DOT now reflects work field, etc., sometimes by a three-digit group,

0-33. Professional nurses,

sometimes by a four-digit subgroup,

Production managers (0-97.50 through 0-97.59),

and sometimes by the fifth digit of a six-digit subgroup,

Metal Sawing Occupations (4-78.600 through 4-78.629),

the new DOT will reflect this throughout the revised structure by the first three digits:

076. Professional nurses

167. Production management occupations

and, under an overall heading "Metal Machining Operations,"

856. Sawing occupations.

*The arrangement that will apply primarily to the counseling process is illustrated beginning on p. 8.

PRINCIPLE 2

Where the present Dictionary reflects skill level sometimes by the first digit,

4 Skilled occupations
6 Semiskilled occupations
8 Unskilled occupations,

sometimes by the second digit,

0-0 through 0-3 Professional occupations
0-4 through 0-6 Semiprofessional occupations,

and sometimes by the third digit,

3-33. Skilled farm machinery operators
3-34. Semiskilled tractor operators,

the new Dictionary will reflect this within each 3-digit group by the last three digits:

013. INDUSTRIAL ENGINEERING OCCUPATIONS

013.081 Industrial Engineer (profess. & kin.)
013.088 Time-Study Engineer (profess. & kin.)

013.108 Production Planner (profess. & kin.)

013.288 Time-Study Man (profess. & kin.) II

The engineering technicians appear in a different classification from the industrial engineers themselves, to reflect different skills and worker functions; however, they are in the same 3-digit group to reflect homogeneity in work field and subject matter. This arrangement also presents information regarding entry and progression possibilities.

Two-Digit Divisions

The categories (p. 6) are divided, in turn, into 87 divisions. These may be useful as a table of contents for the three-digit groups, as a filing system for occupational information in schools and guidance centers, and as classifications for other than fully qualified applicants.

Three-Digit Groups

The two-digit divisions are subdivided into specific three-digit groups. These include not only most of the three-digit groups in the 1949 edition, but also many of the meaningful subgroups (see p. 7).

Specific Classifications

In a complete (six-digit) code number, the fourth, fifth, and sixth digits will identify significant worker functions in the Data, People, and Things areas, respectively:*

*The structure, meaning, and definitions of worker functions will be included in Volume II.

Data (4th digit)	People (5th digit)	Things (6th digit)
0 Synthesizing	0 Mentoring	0 Setting-up
1 Coordinating	1 Negotiating	1 Precision Working
2 Analyzing	2 Instructing	2 Operating - Controlling
3 Compiling	3 Supervising	3 Driving - Operating
4 Computing	4 Diverting	4 Manipulating
5 Copying	5 Persuading	5 Tending
6 Comparing	6 Speaking - Signalling	6 Feeding - Offbearing
	7 Serving	7 Handling
8 no significant function	8 no significant function	8 no significant function

The worker functions, arranged and coded in this way, will permit the last three digits of the code to arrange the jobs in each three-digit group, generally in descending order of level of complexity, and at the same time to identify the specific activities in each job.

Example

In the 1949 edition, skilled, semiskilled, and unskilled GLAZIERS appear in three separate groups: 5, 7, and 9-77. In the new structure, they will appear together in one three-digit group as follows:

801. GLAZIERS

801.381 Glazier (const.)
Glazier, Structural Glass (const.)
Plate-Glass Installer (const.)
Glazier (ship & boat bldg. & rep.)
Glazier Artist (glass prod.)
Joiner (glass prod.)
801.881 Glazier (furn.)
Refrigerator Glazier (refrigerat. equip.)
Glazier, Metal Furniture (furn.)
Glazier (plan. mill)
Safety-Glass Installer (aircraft mfg.)
801.884 Canopy Assembler (aircraft mfg.)
Glazier, mirrors (mirror; mirror & pic. frames)
Lay-Out Man (whole. tr.)
Putty Runner (plan. mill)
Tinner, Glass Setting (plan. mill)
Window Installer (aircraft mfg.)
801.887 Glass Tacker (plan. mill)

Within the three-digit group, the jobs are arranged in descending order of level of complexity instead of being allocated to the three skill levels to which we are limited in the 1949 edition. The group takes only one-third the space of the present 5, 7, and 9-77 groups. It provides, in one place, better information about entry and progression possibilities.

As in the 1949 edition, a job classification is identified by an individual code number (always of six digits in the new structure) and may contain any number of separate job definitions and titles. However, when several jobs have the same code, it will always be because they meet the same criteria; they all meet the definition of the same three-digit group, and all have the same significant worker functions.

Criteria for Establishing Divisions and Groups

The categories are established on a traditional socio-economic basis. The criteria for establishing the divisions and three-digit groups are work field, material, product, subject

matter, service, generic term, and/or industry in some combination. For each category, the specific criteria used are those from the above list which best reflect the skills, knowledges, and abilities involved in the jobs in that category. (We are not concerned here with the worker functions and their related worker traits, as they are reflected by the last three digits of the code.)

In the Professional, Technical, and Managerial category, the divisions reflect broad subject matter areas. The three-digit groups reflect more specific subject matter breaks, but the divisions for managers and officials reflect the major divisions of the Standard Industrial Classification Manual.

The divisions of the Clerical category are based on work field, and the three-digit groups are based on subject matter, service, and type of machine.

Sales jobs involve one work field: merchandising. The divisions reflect three criteria for establishing the three-digit groups of service and sales technique.

The divisions of the Service category are based on type of service, and the three-digit groups are based on generic terms or more specific services.

In the Farming, Fishery, and Forestry category, the divisions and three-digit groups are based primarily on product.

The criteria for establishing divisions and three-digit groups in the Industrial category are primarily work field, material, and product.

WORK FIELD CATEGORIES

00 through 19 Professional, technical, and managerial occupations

20 through 24 Clerical and related occupations

25 through 29 Sales and related occupations

30 through 36 Service occupations

40 through 45 Farming, fishery, forestry, and related occupations

50 through 99 Industrial occupations

TWO-DIGIT OCCUPATIONAL DIVISIONS

Professional, Technical, and Managerial Occupations

00 Architectural and engineering occupations
02 Occupations in earth sciences
03 Occupations in mathematics and physical sciences
04 Occupations in life sciences
05 Occupations in social sciences
06 Occupations in inter-disciplinary sciences
07 Medical and health occupations
09 Occupations in education
10 Occupations in museum, library, and archival sciences
11 Occupations in law and jurisprudence
12 Occupations in religion and theology
13 Writing occupations
14 Occupations in art
15 Occupations in entertainment

16 Administrative specializations
18 Managers and officials, n.e.c.
19 Miscellaneous professional, technical, and managerial occupations

Clerical and Related Occupations

20 Computing and account recording occupations
21 Material and production recording occupations
22 Information and message distribution occupations
23 Stenography, typing, filing, and related occupations
24 Miscellaneous clerical occupations

THREE-DIGIT OCCUPATIONAL GROUPS

Professional, Technical, and Managerial Occupations

00 Architectural and Engineering Occupations

001. Architectural occupations
002. Aeronautical engineering occupations
003. Electrical and electronics engineering occupations
004. Sanitary engineering occupations
005. Civil engineering occupations
006. Ceramic engineering occupations
007. Mechanical engineering occupations
008. Chemical engineering occupations
010. Mining and petroleum engineering occupations
011. Metallurgy and metallurgical engineering occupations
012. Industrial engineering occupations
013. Agricultural engineering occupations
014. Marine engineering occupations
015. Nuclear engineering occupations
017. Draftsmen, n.e.c.
018. Surveyors, n.e.c.
019. Engineering occupations, n.e.c.

02 Occupations in Earth Sciences

020. Occupations in economic geology
021. Occupations in geological specialties, n.e.c.
022. Occupations in general geology
023. Occupations in exploration geophysics
024. Occupations in general geophysics
025. Occupations in synoptic and applied meteorology
026. Occupations in meteorological specialties, n.e.c.
027. Occupations in general meterology
029. Occupations in earth sciences, n.e.c.

03 Occupations in Mathematics and Physical Sciences

030. Occupations in mathematics
031. Occupations in organic chemistry
032. Occupations in inorganic chemistry
033. Occupations in analytical chemistry
034. Occupations in general chemistry
035. Occupations in physics
038. Occupations in astronomy
039. Physical science occupations, n.e.c.

The second three digits (000.000) of the six-digit code provide a second arrangement of occupations according to the worker functions in seven categories.

Worker Function Categories

X88 Data

XX8 Data - People

X8X Data - Things

8X8 People

8XX People - Things

XXX Data - People - Things

88X Things

X - Numeral designating the significant functions

8 - No significant function

The worker function categories will include about 90 three-digit groups.

DATA-THINGS

Groups	Name	Page
081	Engineering and Scientific Research	63
081	Artistic Work	66
187	Engineering	68
181	Cropping, Animal Farming Gardening and Related	69
281 3	Chemical and Materials Analysis and Related	71
281	Drafting and Related	73
287	Appraising and Investigating	75
283	Transporting and Test Driving	76
282	Radio and Television Transmitting and Receiving	77
280 3	Set Up and/or All-Round Machine Operating	78
281 3	Craft Work, Structural and Bench; Processing; Marine and Forestry Work; Mining	87
382	Motion Picture Projecting and Photography Machine Operating	120
384	Scientific Aiding and Assisting	121

Groups	Name	Page
387 4	Inspecting and Stock Checking	122
482 5	Typesetting and Clerical Machine Operating	126
585 6 7	Sorting, Inspecting, Measuring, and Related	127

EXAMPLE

Three-digit group description

ENGINEERING AND SCIENTIFIC RESEARCH

0	8	1
SYNTHESIZING	Speaking-Signalling	PRECISION WORKING

Profile

GED: 5 6
SVP: 8 7

Apt:	GVN	SPQ	KFM	EC
	111	124	333	53
	22	3		45
				4

Int: 7 8
Temp: 0 4 Y
Phys. Dem: see below

Work Performed

Work activities in this group primarily involve researching and/or engineering for such purposes as: designing and developing plans for construction of railroads, terminals, ships, airplanes, automotive equipment, and sanitary projects; developing chemical products, radio, television and allied electronic equipment; investigating properties of metals to recommend new uses; directing design of equipment and tools; planning procedures to increase production, and setting up safety standards in various types of industrial plants; breeding dairy cattle, improving soils, plants, trees, forage crops, food and food products and identifying diseases of the human body from laboratory findings to recommend further research or treatment to be given.

Worker Trait Requirements

Training Time

General Educational Development (GED 5,6): Requirements range from applying principles of logical or scientific thinking to define problems, collect data, establish facts, and draw valid conclusions by interpreting an extensive variety of technical information in books, manuals, mathematical, or diagrammatic form; to application of such thinking to a wide range of intellectual and practical problems making use of non-verbal symbols (formulas, scientific equations, graphs) in their most difficult phases and dealing with most abstruse classes of concepts.

Specific Vocational Preparation (SVP 7,8): Over 2 years up to and including 10 years.

Aptitudes

The most important aptitudes are Intelligence, Verbal, Numerical, and Spatial in some combination.

Intelligence (G 1) is necessary to comprehend the vast amount of technical and scientific principles and data that is required before practical application may be made of this information in design of products, such as ships, airplanes, mechanical or electrical equipment; or in

making accurate observation of soils, forage crops, or animals (to improve quality) or in the diagnosis of human diseases.

081

Verbal (V 1,2) is required for understanding and using language specific to technology involved; communicating results; and preparing reports and articles for publication in journals.

Numerical (N 1,2) is necessary to calculate costs of construction of ships, airplanes, or automotive equipment; to determine dimensions required for fitting parts when designing tools and equipment; in setting up and working out practical problems.

Spatial (S 1) is required for visualizing in the course of designing machinery or structures; determining layout of plant to produce maximum efficiency and production.

Interests

Activities of Scientific and technical nature (7); activities of an Abstract and creative nature (8).

Temperaments

Situations involve: Direction, control, and planning of an entire activity or the activities of others (4); Evaluation of information against measurable or verifiable criteria (0); Precise attainment of set limits, tolerances, or standards (Y).

Physical Demands

These activities require the ability to perform Sedentary (S) or Light (L) work; Reaching, Handling, Fingering, and Feeling (4); and Seeing (6). Some require Talking and Hearing (5).

EXAMPLE

Job title arrangement in a three-digit worker function group

081
ENGINEERING AND SCIENTIFIC RESEARCHING

0	8	1
SYNTHESIZING	Speaking-Signalling	PRECISION WORKING

00 Architecture and Engineering

001 ARCHITECTURE AND ARCHITECTURAL ENGINEERING

001.081 Architect, (profess. & kin.)
Architect, Marine (profess. & kin.)

004 ELECTRICAL AND ELECTRONICS ENGINEERING

004.081 Electrical Research Engineer (profess. & kin.)
Radio Engineer (profess. & kin.)
Radio Engineer (radio & tv broad.)

005 CIVIL ENGINEERING

005.081 Construction Engineer (profess. & kin.)
Highway Engineer (profess. & kin.)
Hydraulic Engineer (profess. & kin.)
Railroad Engineer (profess. & kin.)
Sanitary Engineer (profess. & kin.)

007 CERAMIC ENGINEERING, GLASS TECHNOLOGY

007.081 Ceramic Engineer (profess. & kin.)

008 MECHANICAL ENGINEERING

008.081 Air-Conditioning Engineer (profess. & kin.)
Automotive Engineer (auto. mfg.)
Combustion Engineer (profess. & kin.)
Internal-Combustion-Engine Designer (profess. & kin.)
Machinery and Tool Designer (profess. & kin.)
Plant Engineer (profess. & kin.)
Power-Plant Engineer, Steam (profess. & kin.)
Refrigeration Engineer (profess. & kin.)

010 CHEMICAL ENGINEERING

010.081 Chemical Engineer, Research and Development (profess. & kin.)
Dehydration Engineer (petrol. production)
Design Engineer, Refinery (petrol. refin.)
Mud Engineer (petrol. production)
Sand Technologist (found.)

011 MINING AND PETROLEUM ENGINEERING

011.081 Mining Engineer (anth. coal mining; bit. coal mining)
Petroleum Engineer (petrol. production)

012 METALLURGICAL ENGINEERING AND METALLURGY

012.081 Metallurgist, Extractive (profess. & kin.)
Metallurgist, Physical (profess. & kin.)

02 Mathematics and the Physical Sciences

022 CHEMISTRY

022.081 Chemist, Food (profess. & kin.)
Chemist, Food Containers (can. & preserv.; tinware)
Chemist, Glass (glass mfg.)
Chemist, Industrial Alcohols (alc. distilling)
Chemist, Metallurgical (profess. & kin.)
Chemist, Physical (profess. & kin.)
Chemist, Physiological (profess. & kin.)
Chemist, Textile (textile)

07 Medicine and Related Health Care

072 VETERINARY MEDICINE

072.081 Veterinary Bacteriologist (medical ser.)
Veterinary Pathologist (medical ser.)

073 PHARMACOLOGY

073.081 Pharmacologist

DEVELOPMENTS IN MANPOWER AND PERSONNEL PLANNING IN DEFENSE

G. C. Lee

Office of the Assistant Secretary of Defense
Department of Defense

(Paper not available for publication)

PART II
OVERVIEWS OF MILITARY PERSONNEL-SYSTEMS RESEARCH PROGRAMS

AIR FORCE PERSONNEL-SYSTEMS RESEARCH

Lt. Colonel Edward F. Rodriguez, USAF

Directorate of Personnel Planning
Headquarters, USAF

This year's conference on New Approaches to Personnel Systems Research is a timely one. From where I sit in the scheme of things, at Hq., USAF, it seems to me that in the Personnel business "new approaches" and "the use of computers" are fast becoming synonymous. This is because data can be handled so much more rapidly with computers. While research agencies are handling more data to predict group behavior with greater reliability, the personnel manager is using computers to handle more data on individuals than was heretofore possible.

The Air Force presentations will cover both sides of this picture. Today's presentation by Mr. Abel of the Personnel Systems Group will cover the work done in preparing to handle individuals. Tomorrow's presentation by Dr. Christal of the Personnel Research Laboratory will cover projects of tri-service interest dealing with groups.

During the next few minutes I want to provide an introduction to the Air Force Personnel Systems Research Program and to set the stage for presentations to follow.

The Air Force Personnel and Training Research Program includes research and development to support the operation and improvement of the Air Force Personnel System. This includes development and evaluation of concepts, and techniques concerned with occupational analysis, personnel procurement, classification, training, assignment, and all the other functions that are included in managing our personnel force.

The Deputy Chief of Staff for Personnel, Hq., USAF, validates the requirements for research and development to support the Air Force Personnel System. He recommends a level of effort to be allocated to each functional area, within available dollar and man-year resources. He insures that each directorate within his office takes the necessary steps to (a) evaluate proposals for research projects, (b) participate, as necessary, in planning the projects, (c) coordinate project plans, (d) take the necessary follow-up action to see that projects are progressing satisfactorily, and (e) use the research and development products. He is responsible for forwarding the validated requirements to the Director of Research in the Deputy Chief of Staff for Research and Technology.

The Director of Research is responsible for requesting the Air Force Systems Command to prepare a project plan in support of the validated requirements, to coordinate the proposed project plan with the Air Staff Agencies concerned, to approve or to disapprove the project as planned, and to provide project guidance.

In order to organize a research program for management and documentation purposes, the Air Force Research and Development program is made up of the following four programs:

1. Command Operations
2. Operational Development
3. Advanced Development
4. Research

The Command Operation Program identifies programs used by the Systems Command for intracommand management.

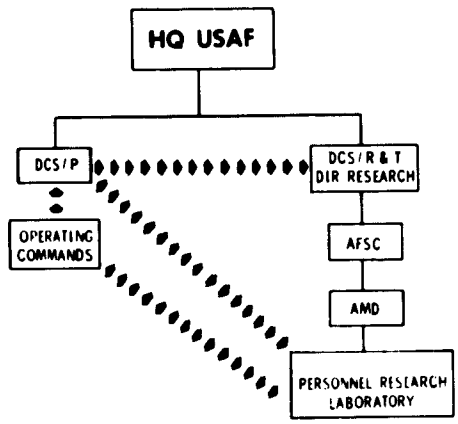
The Operational Development Program is limited to developments undertaken in response to near-term operational requirements.

The Advanced Development Program is designed to fulfill anticipated long-range operational capabilities beyond present technical capabilities or to exploit significant technological advances.

The Research Program, the program in which we are particularly interested at this conference, is divided into Applied Research Programs and Basic Research Programs and covers the fundamental investigation of all activities and phenomena in which discovery of applications of interest to the Air Force may be expected. Research program structures codes are reserved for Applied Research Programs. These codes run from 710A, which identifies applied research in Nuclear Weapons Effects, through program structures code 790A which identifies research in Systems Syntheses and Analysis. Code 780E identifies applied research concerned with Human Performance. The various DD Form 613's which document approved research programs in the area of interest to the Army and Navy, as well as to the representatives of other agencies at this conference, are all identified by Code 780E.

Operating command, as well as Air Staff activities, forward proposals for research projects to the Deputy Chief of Staff, Personnel, Hq., USAF. Requests must be fully justified to include what result is expected. The DCS/P coordinates, as required, and forwards the validated requirements to the Director of Research. The Director of Research requests the Air Force Systems Command to prepare a plan in support of the validated requirements. Once the project plan is accepted it becomes a Hq., USAF, directed project, and filters down to the Personnel Research Laboratory where a RDT&E card is prepared and approved. The project card summarizes the research requirement objective, the various subtasks assignments, funding in terms of dollars and manpower, and lists the project scientist and the various task scientists. The program then gets underway. Once the program is an on-going project, Project Monitors in Hq., USAF, are authorized direct communication with the Personnel Laboratory. Direct communication may be authorized between the Personnel Research Laboratory and the operating command, who may or may not have requested research, especially when subjects needed by the Laboratory are assigned to the operating commands.

I hope that this brief explanation will assist you in following the Air Force presentations. It is, I admit, "broad-brush," so if you are interested in added information about any particular aspect, we will be pleased to provide information on an individual basis.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OPERATING
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PERSONNEL RESEARCH
LABORATORY

ARMY PERSONNEL-SYSTEMS RESEARCH

Harry I. Hadley

Personnel Management Group
Department of the Army

INTRODUCTION

The Army Personnel Systems Research Program is, of course, of tremendous scope and encompasses far more than could be even touched upon in this short period. In its broadest sense, personnel-systems research could cover almost all scientific study which uses man, or in our case the soldier, as the subject. Selection and related psychological research is conducted by the Army Personnel Research Office (APRO), which issues specific technical reports and summary Quarterly Reports. Training research and related Human Resources research is conducted by the Human Resources Research Office (HumRRO) of the George Washington University under contract with the Army. Here again both specific project reports and summary reports are issued. One of the later Army speakers will give us a run-down on the work being carried on by HumRRO which is relevant to personnel and man-weapons systems. Additionally, much of the equipment research conducted for the Army results in findings or basic data applicable to personnel systems. Generally, the findings of equipment research are published as an annex or appendix to the equipment report. A recent example was the extensive task and skill analysis which accompanied the report on the Pershing missile.

OCCUPATIONAL RESEARCH PROJECTS

Most of the research that I have mentioned is well known to scientific and technical personnel. However, I would like to mention research studies and programs, directly in the personnel system area, which may not be as well known or as readily available. I refer to those projects grouped under the title Occupational Research. While closely related in some respects to the already mentioned areas of research, Occupational Research differs in that the "job" and its requirements serve as the basic point of orientation. Briefly, some of the completed or on-going projects in this area which give evidence of improving Army personnel systems are as follows:

1. A personnel system for the technician-level job. This is the Army's new Warrant Officer program recently published as AR 611-112. It will be reported on in some detail by one of our later speakers.

2. Redefinition and grading of the instructor job. The aim of this project is to separate the high-requirement platform instructor job at the enlisted level from auxiliary positions such as classroom demonstrators and field problem assistants. Over 3000 job-requirement questionnaires have been gathered and are now undergoing machine analysis. It is anticipated that the true instructor job can be isolated from lower requirement positions and that an equable grading pattern will be authorized. The results of this research will be published during FY 63.

3. Revision of the enlisted MOS structure. A General Staff Committee has conducted a six-month study of the responsiveness of the current enlisted MOS system to the needs of the Army during the 1962-1970 time frame. The report of this committee has been completed but has not yet been released. Among the areas on which the Committee made recommendations are

(a) Standardization of job qualification levels Army-wide

(b) Techniques for classifying MOS subspecialties or job "shred-outs"

(c) Integration of environmental and "add-on" skills, such as arctic warfare, language qualification, and security clearance, with the regular occupational job requirements so that a single personnel classification and assignment system results.

4. Automated job analysis. Research effort in the area of job analysis seems to be indicating that if we are to capitalize on automatic data processing equipment in the job analysis field, we must define the job solely in terms of what the soldier "does do" and eliminate unquantifiable qualification statements and other "must know" items. This project is only in its beginning stages, however, and much remains to be done.

5. Occupational mobility. Data on about 1500 cases of personnel moving from one occupational area to another were collected in an effort to determine if occupational mobility can be predicted. A summary of the interim findings of this study was published last Fall. As the Army has recently changed its personnel utilization rules, data collection had to be suspended on this project. It will be reinstituted shortly, and it is anticipated that the full results will be published during FY 63.

6. Officer job evaluation. A study is currently underway on evaluating and grading officer jobs in combat units which do not conform to the division and field army pattern. Comparative data on officer jobs in Continental US Air Defense units have been collected and are being correlated with existing data on bench mark jobs in a standard infantry division and a field army.

7. MOS feasibility study procedure. A recently published AR established a comprehensive system of Occupational Research in conjunction with new equipment research and development. The MOS Feasibility Study has become an integral part of the total feasibility study associated with any new qualitative materiel requirement. Occupational analysis is now conducted during both the initial and developmental stages of equipment research, and this analysis forms a part of the body of opinion presented to the General Staff at the time missile and other equipment research requirements are submitted for approval. The MOS Feasibility Studies also yield qualitative and quantitative personnel-requirements information for field testing of new equipment and for the organization and staffing of new units.

CONCLUSION

I have mentioned only a few of the many projects completed or ongoing in the area of Personnel Systems Research. Many of the others are of equal import. However, in the short time remaining, I would like to mention a few areas where I believe additional research effort and searching examination are needed.

1. Additional work in the job evaluation area is needed. Particularly in joint units or in military-civilian units, we lack across-the-board job evaluation factors with adequately defined levels.

2. Some additional basic research in standardizing terms, such as task, duty, duty position, and career field, so that communication could be improved.

3. Officer career patterns and projected officer job requirements are likewise long-neglected areas in which research projects are needed.

4. A system of job engineering slanted toward conservation of the human resources allocated to the military forces is developing into an increasingly critical requirement in the Occupational Research area.

In conclusion, let me say on behalf of the Army that we are happy, as always, to participate in these annual conferences.

NAVY PERSONNEL-SYSTEMS RESEARCH

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Significant progress and accomplishments have been attained in the Navy's personnel-systems research program during the past several years. However, before I give an overview of our specific research projects, perhaps it is appropriate to outline the organizational framework within which the Navy conducts this type of research.

In the Navy research organization, primary responsibility for personnel-systems research is assigned to the Bureau of Naval Personnel. Supplementing the BuPers research effort are assist programs by several of the technical bureaus, CNO, and ONR. For example, BuWeps, BuShips, and BuMed are conducting significant research efforts in the improvement of Naval personnel systems commensurate with responsibilities as assigned by Navy Regulations or higher authority. The Office of Naval Research, which is sponsoring this tri-service conference, also is active in this area, particularly in basic research and in projects sponsored by the Personnel and Training Branch, Psychological Sciences Division.

The time allotted to this presentation does not permit me to enumerate the pertinent projects which are a direct or indirect outgrowth from technical-bureau-sponsored projects. For purposes of this presentation I am limiting my overview to that research accomplished by BuPers, with particular emphasis on research under the guidance of the Personnel Systems Research Branch.

Specifically, the Personnel Systems Research Branch is responsible for administering the Chief of Naval Personnel's research program for the development and application of classification and coding systems, career structures, qualifications and staffing standards, manpower information and accounting procedures, organizational patterns and methods for determining qualitative/quantitative manpower and training requirements. Research in support of this mission during FY 1962 has been classified primarily under the following four major exploratory development areas in the personnel administration category.

1. Systems analyses studies and tests. Research in this area deals with possible future personnel-administration systems. Projects are designed to determine the characteristics for advanced techniques, methods, etc., to be developed or that lead to proposals for personnel-administration systems that will utilize fully advanced techniques and methods. Among the major research accomplishments are:

a. development of mathematical model of personnel production process (22 ratings) utilizing operation research techniques

b. improved officer personnel system integrating officer qualification coding structure with officer billet coding system

c. improved Navy enlisted classification structure suitable for use in defining requirements in allowances

d. development of new mobilization code substitution structure, enabling detailers to select military personnel with closely related skills for specific assignments when fully qualified personnel are not available.

2. Qualitative/quantitative requirements. Research includes development of methodology for, and the establishment of, naval personnel requirements, in terms of numbers of each classified skill, and the development of qualitative standards. Among the major research accomplishments are:

a. qualitative and training requirements for officer and enlisted billets for use in maintaining the highest standard of personnel readiness in ASW

b. proposed standards and qualitative/quantitative requirements for selected areas of line officer subspecialization

c. development and refinement of postgraduate officer billet and training requirements

d. development of qualification and training standards for Meteorological officers

e. qualification standards for restricted line officers

f. development of qualitative standards for newly established ratings of Data System Technician and Aviation ASW Technician designated to provide more competent maintenance personnel in support of new and complex systems

g. improved qualifications standards for development of proficiency in ordnance, missilry, and weapons control to meet changing and increasingly complex air and surface operational and maintenance requirements

h. development of qualifications standards for ASW officers

i. development of new techniques for determining minimum skills and knowledges for naval ratings, using automatic data processes

j. development of training and selection requirements for the Naval Aviation Officer (NAO) program

k. development of qualification standards for Supply Corps officers

l. development of qualitative/quantitative requirements for Naval Reserve officers in Supply Corps, Harbor Defense, and MSTS programs

3. Reporting data processing and accounting. This exploratory development research requirement encompasses the management of personnel records including data gathering, computing, recording, updating, and retrieving. Among the major research accomplishments are:

a. development of foreign language coding proficiency structure

b. refinement of officer education coding structures, and integrating various codes, such as PG codes and civilian college codes, into single integrated structure

c. development of enlisted training accounting structure.

4. Organizational analysis research. Projects included herein encompass organizational studies which lead to improved organizational/manning structures. Among the major research accomplishments are:

a. manning criteria for a recruit training command for use in developing personnel requirements under peacetime and mobilization situations

b. manning criteria for naval station functions for use in developing personnel requirements under peacetime and mobilization situations

c. manning criteria for use in developing manpower requirements for Electronics Technicians and Fire Control Technicians as applied to equipments currently in the fleets

d. manning criteria and organizational requirements for use in developing naval personnel requirements and ship's organization structure for an AGMR (major communications relay ship)

e. manning criteria for use in determining manpower requirements for Yeoman and Personnelman for ships, aircraft squadrons, and shore activities.

But perhaps even more significant than a listing of accomplishments attained this fiscal year is a report on planned personnel systems research for FY 1963. In addition to a comprehensive program of new developments research in order to keep both ahead and abreast of "hardware" advances, BuPers research is planned on an in-house and contract basis to accomplish goals such as:

1. Development of officer/enlisted personnel systems suitable for the 1970 Navy

2. Development of methods for accurate forecasting of naval knowledge and skill inventories

3. Development of methods to identify mobilization skill requirements

4. Development of methods for analysis of impact of new developments in personnel requirements

5. Analysis of technician utilization and development of means for improvement

6. Development of improved fleet personnel readiness through billet engineering.

In the Navy's presentations this afternoon you will hear reports from (a) a Navy contractor who will discuss an operations research approach in studying the interaction of the various facets of the Navy enlisted personnel system, and (b) an in-house report from a representative from one of our laboratories. He will discuss an approach in training requirements research which is having a real pay-off for the Navy in assuring that reserve officer training is geared to produce officers qualified to fill mobilization billets.

During the discussion periods, representatives from both our San Diego and Potomac River Naval Command research activities, as well as myself and others from BuPers, will be available to give additional information if desired.

PART III
SPECIFIC RESEARCH PROJECTS

PROCEDURAL AND MECHANIZATION RESEARCH TO SUPPORT PERSONNEL-SYSTEMS DESIGN

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INTRODUCTION

The scope and variety of computer applications leaves no doubt that we are witnessing a phenomenal growth in an information technology. This technology, or systematic treatment of data, is having a profound impact on every aspect of our civilian economy and our military operations. Such new applications as the controlling of automobile traffic in downtown Los Angeles, the preparation of the classified section of a daily newspaper, an automatic drafting device converting complex formulas into structural and part drawings, a new self-adjusting automatic pilot, and, a simplified method of retail purchasing at a discount supermarket in France are appearing daily.

In the Directorate of Military Personnel, we see these three major applications of computer capabilities: interrogation, display, and simulation. Beside discussing these applications in detail, I will also touch upon our basic personnel-information flow, our master plan for personnel-system improvement, and some aspects of machines and the personal touch.

INTERROGATION

An effective manner in which we are using the interrogation capability of a computer is illustrated by the Colonel's Assignment Group at the Pentagon. The problem here is to find the best-qualified man to fill a vacancy for a Colonel. In the past we had the alternative of relying on personal experience as to who best fitted the job requirements, or of "eyeballing 5000 records." No method that was employed to narrow the search through the 5000 personnel jackets containing the individuals service histories could assure that everybody eligible was considered and, consequently, that the most qualified individual received the assignment. Now, however, we utilize the interrogation capability of computers.

The interrogation of our data bank is easily prepared by indicating the desired elements on a Request for Screening form. Incidentally, although we are not employing it to date, the technology now provides for plain English (COBOL — Common Business Oriented Language) inquiries to the data bank. One sheet is prepared for each vacancy; all sheets are collected and submitted to the computer each night. The following morning, all Air Force Colonels meeting the mandatory requirements are submitted to the Colonel's Assignment Group as a list of eligibles.

The problem thus narrowed, the assignment officers can now explore in depth each individual career summary sheet, effectiveness reports, favorable (and unfavorable) communications, and other information by pulling their individual personnel jackets.

A recent interrogation of the computer data bank to find eligible Colonels to fill a wing commander's position overseas considered each of the 5000 Colonels for each assignment, permitted exhaustive investigation of the eligibles, and also provided significant clerical assistance.

A similar technique has been employed by the Air Training Command (ATC) for over two years, and they are now developing procedures and techniques for use at Major Air Commands for the management of all our officer assignments.

In addition to the data provided for the selection of Colonels, this system will provide many more criteria on which to screen. (Personnel data elements on magnetic tape for each officer are being increased from 51 to 65.) Furthermore, the system under development at Hq., ATC, will provide current status information on authorized/assigned (command-wide); and show grade and skill distribution by subordinate organizations. With information indicating the best qualified officer available on the one hand, and with information showing the relative needs of subordinate units on the other, faster and more accurate selections are possible.

Command representatives have met with project personnel at Hq., Air Training Command, to be sure that the peculiar requirements of their command have been considered. Another meeting is scheduled in early July. After this meeting we must "harden" on system changes so that the necessary detail of defining computer instructions (programming) can be accomplished in time to meet our Jan. 1963 operational commitment.

The interrogation application highlights the nature of the supporting role of this information technology. We permit the computer to screen on quantitative information, but we reserve the qualitative factors for individual judgement. Or stated differently, we must constantly stand guard in personnel assignments against considering only those factors that can be quantified. We must not get lazy or impatient. The proper combination of computer assistance and personal judgement will result in more accurate and faster assignment decisions.

DISPLAY

In my first example, I assumed that we knew the particular job vacancy and were concerned with finding the best-qualified individual to fill it. However, decisions as to what positions to man and from what source to draw require accurate and current manpower/resource information that is not available to our managers today. Extraction from the data bank, in varying degrees of detail, is desired. Information and its visual presentation is highly desirable. (Video is here now, but data will be presented in computer-produced paper form for the immediate future.) The elimination of voluminous reports, which are very costly and have very limited management value, is another goal because such documents attempt to provide both summary and detailed information without showing their interrelationships.

To reap the full benefits of the state of the art here, information must be displayed in front of the decision maker to give him a perspective from which he can then ask his computer intelligent questions.

In the solution to the complex problem of matching skilled personnel resources against the demanding and ever-changing requirements for them, we must examine many alternatives and adopt the best compromise in the face of shortages. We must constantly search for the most fruitful resource, considering the manning status of every skill and the qualifications of all potential candidates. To do this, a perspective is required. The maintenance officer manning section, for example, in order to fill vacancies on a world-wide basis, requires a display tailored to its needs to provide, through interrogation, both a perspective and a guide to detail. We take action in detail but exercise judgment from perspective.

In making an assignment, the game is to match each individual's highest skill with a position which demands this ability.

If we have a coordinate system in which all the maintenance jobs to be performed are on one axis, identified by skill, then on the other axis we will have the maintenance officers identified by the highest skill in those same skills. When men are plotted against jobs by actual duty, perfect assignments fall on the diagonal at the exact intersections. The greater the distance from the diagonal, the less use is being made of the highest ability of the individual. The process of shifting personnel on a world-wide basis, with numerous gains and losses, replacement training, etc., requires a generalized display of this type so we can keep pushing people toward the diagonal.

At the end of a day of interrogation and decision making, all decisions are fed to the computer for up-dating the data bank. The next day's display reflects all decisions made.

All personnel functions require a display of a major portion of the Air Force-wide general picture in order to provide a pattern from which decision makers can grasp a framework for making decisions. Interrogation is then intelligent. In addition, everybody on the Air Staff is working from the same daily updated data base. For instance, if 500 Majors are promoted today, all assignments of these selected Majors decided upon today will be rejected by the computer and returned for further review. This provides a mandatory coordination process.

Displays take a wide variety of forms: line graphs, bar graphs, geographic dispersion, or you name it. Line or bar graphs can now be produced directly from magnetic tape or punch card.

We need experience with computer-produced displays to help us in establishing display scope, format, frequency of up-date, etc. We also need experience in using interrogation in conjunction with a display. Clearly there's a great future in this technique for us.

Equipment on the shelf and state of the art already exist for by-passing the machine-produced paper display and going directly to visual display on TV tube or projection screen with console manipulation of data. For instance, you can touch a number on a grid with a light-sensing pencil, then touch the diagonal with a voltage pencil, and the computer will alert the individual, cut the orders, and up-date the data base. Some of our victims probably will accuse us of playing tic-tac-toe as we evolved their assignments, but this is the price of progress.

We are not ready to use this sophistication. We must design and get experience in using perspective displays on an economical, yet rapid, basis first. We may never require this sophistication for action officers, but we will definitely require it for top management's status and trends interrogations.

SIMULATION

However valuable interrogation and visual displays are proving to be to our managers, the largest payoff by far will be in the area of simulation. Here we are seeking means to simulate real-life situations, to establish interrelationships, and to pretest results without the expensive and confusing efforts resulting from trial and error which are characteristics of our traditional empirical approach. (All of us in Personnel flinch when we look back on some policy change which turned out badly and had to be reversed.)

We seek a capability, in this area, of simulating "real" personnel situations in matching our personnel requirement versus resource in the numerous possible situations which present themselves. The value of past experience in deciding courses of action decreases as we move farther into the future with the concurrent requirement to move much more rapidly because of technological demands. An obvious requirement is to establish personnel applications to simulate the effect of program changes on personnel. This will be our first major effort in simulation.

Permit me to single out a simple illustration of the simulation technique which is of interest to the Department of Defense in terms of their present day study. Mr. Gorham, Study Director of the Department of Defense Study Group on Milltary Compensation, has indicated that the need to correct chronic skill imbalances is an important part of the groups work. Shifting incentives to the more difficult, yet more valuable, retention groups may provide a solution to this problem. The Air Force has set a goal that 55 percent of its airmen be career personnel that are serving their second or subsequent term of enlistment. However, this percent varies. For example we want only 48 percent to be career men in the food service field, with 60 percent being career men in the more complex radar field.

There are many decision variables by which management retains personnel or limits their retention, and thereby controls the mix.

Let's look at the condition which exists in the Radar Maintenance Field, one of our chronic high-skill shortage areas. When we look at the optimum force by years of service versus actual inventory we note that we are far below the optimum in the 10- to 30-year service bracket.

In one of the least technical fields, the opposite condition prevails. In the food service field we have great numbers of career airmen in the 8- to 20-year service bracket. They bring with them large numbers of dependents, great service costs (BX, medical, etc.), and place great numbers in the retirement eligibility zone. In addition, personnel in the less technical fields tend to acquire higher grades, by reason of their seniority, than would be justified based on complexity of skill.

We require an ability to test decisions which would limit the career airmen we keep in these nontechnical fields, and decisions which would enable us to keep more of our highly technical career airmen.

A model for simulating decisions shows our force by years of service. We know the current inventory, optimum goals, and gain and loss rates by career field. By applying these to our projected inventory for several years we arrive at the variances. Then we can make decisions, such as limiting reenlistments in the less technical fields and increasing prior service procurement for the complex field. The model can then be used to test these decisions by the process of aging the projected inventory with these decision factors added. We can see how well we overcome the unfavorable variances which had been reflected without the influence of these added and tested factors. We then get a picture of the effect on the airman population, by career field and in total, as a computer-output product, and we can decide whether to implement the suggested course of action.

Essentially we will have tested the effects of the decisions over a long period of time without having followed the trial-and-error route on the basis of judgment alone. Many other areas lend themselves to this type of simulation.

PERSONNEL-INFORMATION FLOW

Thus far I have touched upon some aspects of this growing information technology in terms of how it can assist us in our personnel decisions. The basic building blocks making this possible consist of timely, accurate, and complete data.

Our planning provides for centralization of the records keeping function at base level. Simple mechanical support in the base personnel office (consisting of card punch, sorter, and document writer) is being provided.

Changes affecting personnel are put in form for mechanical processing (IBM cards), checked, and submitted daily to major air commands (MAC) for computer processing. Management output products required at each headquarter of MAC and subordinate echelons will be produced as required by the MAC computer. Base level and MAC transactions will be submitted weekly to HQ., USAF, where detail files will be maintained on each officer and airman.

Timeliness of our information will be significantly improved. The data bank at each MAC will be not more than a few days old, and at Hq., USAF, not more than 10 days old. This is in contrast with the 45- to 90-day-old data that we now have.

New controls are being established to improve accuracy. We are preparing detailed machine instructions (in COBOL) at Hq., USAF. These instructions will provide for extensive use of the logic capability of the computer at each MAC in terms of checking the data submitted from the bases. Where errors are found, they will be returned for correction within a day. Further controls in accuracy are being prescribed at base level. Another improvement from a management point of view is that we have fixed responsibility for basic data accuracy and, consequently, can pinpoint individual responsibility on the personnel staff. We, the personnel people, are now fully responsible for the accuracy of all personnel input data.

MASTER PLAN FOR PERSONNEL-SYSTEM IMPROVEMENT

Meeting management's requirements with the data elements collected and processed thru the system is a matter of an exhaustive system design effort. In January 1963 (for officers) and July 1963 (for airmen) we will prescribe significant increases in the number of personnel data items that are now maintained at major air commands and at Hq., USAF. As we further delineate our management requirements in the 1965 time frame, some additions to our data base may be expected. Our manpower files will be as current as the file we are establishing on our personnel resources and will be responsive to our information needs. In other words, we will be taking current manning action based on current statements of manning requirements.

Our current demands for information on our resources far exceeds that which the system will now produce. It is probably fair to say that an information crises now exists in personnel, as well as in other resource areas in the military and in many large corporations. Fortunately, the Air Council recognized this several months ago and took positive action to overcome it. Among other things, it established a coordinating office under the Comptroller, called the Office of the Assistant for Data Automation, to tie together the many developments contributing to any increased capability in this area. From a personnel point of view, the most significant development at the referenced Air Council briefing was the recognition of the role of each functional area in terms of accomplishing its own system design. Prior to this decision, little effort had been directed to rethinking in the prerequisite detail as to just how we wanted to manage our personnel resources. By default, the work that had been done in this area was largely accomplished by the Comptroller. Lack of adequate emphasis in this area found us lagging sadly behind the state of the art.

An overall plan for the improvement of our personnel management capability has been established. It provides for the centralized control of the design characteristics and the decentralized development by major air commands wherever possible. It is obvious we will never possess the personnel resource to do this job centrally. I have already made reference to one project being developed under this concept, the Centralized Assignment of Officers at major air commands. In this instance, the Air Training Command is the prime development agency for the Air Force, reflecting in the system that it develops the varied requirements of other commands at the time of the next major change in our personnel data system, Jan. 1, 1963.

Similar development projects have been assigned to other major air commands by a series of Air Force Letters: SAC has the centralized assignment of airmen at major air commands; ATC has the selective procurement of airmen; TAC has base-level mechanization; and, SAC will develop the base-level computer application.

In all the functional areas that are part of a total personnel system, actions in any one area, of course, affect one or more of the others. Our system design provides for this. Furthermore, the several development projects assigned to the major air commands will ultimately fit together into a single system.

MACHINES AND THE PERSONAL TOUCH

We must insure that we do not default our management responsibilities to the "black box." Recognizing that this could happen, we must constantly guard against it. We must recognize that whereas the computer can handle those factors that can be quantified, it cannot begin to handle the several areas where judgment is involved in the personnel business. I feel that we can, and must, allay fears of "computer made" decisions by:

1. Designing a system in which the computer is a slave to the personnel staff officers judgement process.

2. Educating our people as to how both knowledge of the man and opportunity for the man are being maximized.

3. Using the computer capability, once we design a system to exploit it, in such a manner that the development preference of all individuals, especially our younger people, of great ability get the same consideration that is currently given to the more experienced people.

THE WARRANT OFFICER AND THE TECHNICIAN-LEVEL JOB

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Personnel Management Group
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The purpose of this presentation is twofold:

1. To attempt to describe what a technician is, and

2. To estimate the extent that the Army warrant officer approximates this description.

Since World War II, technological progress has caused industry to experience an ever-increasing, well-publicized need for scientists and engineers. Accompanying this need has been a lesser known, but nonetheless significant, requirement for competent supporting personnel who possess certain special technical abilities. During the past decade, these personnel began to appear in sufficient numbers to attract attention as a new class of workers in the civilian economy. Popularly referred to as "technicians," they gained specific recognition in the National Defense Education Act of 1958, in which Title VIII authorized assistance to the states for the purpose of developing vocational education programs to train youths and adults for "useful employment as highly skilled technicians in recognized occupations requiring scientific knowledge."

Although still in a formative stage, the technician job appears to belong at a level that is immediately below the professional occupations on the one hand but definitely above the skilled manual trades on the other. Perhaps the technician job may be most appropriately characterized as "semiprofessional" or even "subprofessional." At any rate, it involves work performance with professional personnel at some stages and with skilled craftsmen at others.

The qualifications of the technician job embrace merely a segment of the total knowledge of the parent professional occupation. Yet, these qualifications do not reflect the relatively fixed specialization characteristic of the manual trades. Instead, they are based upon rather broad-range knowledge so that they can respond quickly to technological change and adjust readily to performance of new duties.

Normally, qualifications for the technician job are acquired through completion of two years of a post-high-school technical curriculum. Unlike the traditional trade schools, institutions providing this type of training are variously known as technical institutes, junior colleges, community colleges, and vocational institutes.

Although emphasis to date has been largely on physical sciences and engineering, technician jobs also extend into the social science areas. Accordingly, the word "technician" is considered to connote skill in the technicalities of a subject and to have been derived as much from the word technique as from the word technical, which is more commonly used in connection with hardware. Following are examples of technician-level occupations:

DENTAL TECHNICIAN

ELECTRONICS TECHNICIAN

ENGINEERING AIDE or ASSISTANT

FIELD TECHNICAL REPRESENTATIVE

MACHINE DESIGNER

MAINTENANCE ADVISOR

MEDICAL TECHNICIAN

PRODUCTION TECHNICIAN

TOOL DESIGNER

TECHNICAL SALES REPRESENTATIVE

Currently, the Army is completing implementation of a new Warrant Officer Career Program. This program has been gradually phased into being over an extensive time period in order to let attrition minimize any inconvenience or hardship otherwise likely to be experienced by personnel. In the program, the warrant officer is described as a "highly skilled technician." In addition, many of the duty position titles and most of the occupational classification titles contain the word "Technician." As a result, it is pertinent to this presentation to attempt to determine whether or not the warrant officer and his job merit the title "technician" and occupy the "Technician Level" in the same sense as the emerging technician group in private industry.

Originally, the Warrant Officer Corps was established to fill a distinctive occupational requirement. Over the years, however, a combination of expansive legislation, emergency executive orders, expedient utilization practices, and decentralized wartime administration tended to blur the distinction between the warrant officers and other categories of personnel. Finally, in 1953, an impending reduction in force levels focused attention upon the corps and its anomalous status. When subsequent studies demonstrated that the Army had an occupational requirement for a separate category of personnel, it was decided to establish, revitalize, and utilize the Warrant Officer Corps to fill this requirement. This became and has remained the primary purpose of the new program. If, in the process, the warrant officer has become a technician, it has been as a result rather than as an objective of this program.

When development of the program began in 1954, the word "technician" was selected as a job title and has since become firmly accepted. Viewed in retrospect, its choice now appears attributable either to a considerable degree of foresight or an unusual degree of coincidence. Actually, it was neither. It was inevitable as the only logical response to the same technological progress that was concurrently creating the so-called technician in industry. As positions were evaluated against criteria established for the program, it was noted that those which ranked lowest were administrative in nature. Conversely, those which tended to rank highest were concerned with the operation and maintenance of mechanical, electrical, and electronic equipment and, therefore, "technical" in nature. From this use of the word, "technical," the title "technician" evolved although it has long since outgrown its earlier connotation.

The extent to which the warrant officer job may be of technician level was further influenced by certain problems encountered in the development of the program. Coping with these often required solutions and concessions that, in turn, tended to shape the eventual character of the program and leave an imprint on many warrant officer jobs. Among these problems were the following:

1. Current statutes define the warrant officer as an officer, but rank him below the commissioned officer; require promotion on a corps-wide "up-or-out" basis, which makes it difficult to promote by MOS; and vest in him most of the powers possessed by commissioned officers.

2. From an annual budgetary standpoint, the warrant officer and the commissioned officer are identical. Thus, an increase in the strength authorization of one requires a corresponding decrease in the strength authorization for the other.

3. The warrant officer corps is subject to a relatively low and firmly maintained strength ceiling.

4. A separate category of personnel implies a separate level, but positions reflecting such a level do not exist consistently in Army manning tables. Yet, positions cannot be added to create such a level because of the strength ceiling and risk of overstaffing.

5. Above the enlisted level, positions tend to fall into one of two categories: (a) supervisory in whole or in part, and (b) nonsupervisory, but requiring a professional level of qualification.

Essentially, the program attempts to provide for a highly exclusive type of personnel utilization within the confines of a low and firm strength ceiling. It does this by designating positions considered to require assignment of a separate category of personnel and then insuring that only warrant officers are utilized in these positions and in no others. All phases of the program are governed by highly specific and meaningful statements of policy, criteria, and guidance. The basis of the program is, of course, the authorization of positions. Although the criteria used for this purpose is extensive, it merits presentation in condensed form because of its reflection of the technical nature of the warrant officer job. Authorized for warrant officer assignment are positions:

1. That require a higher degree of technical skill than that required at the enlisted level.

2. That require unique aptitudes, abilities, talents, or capacities.

3. That are predominantly concerned with the technical details of the professional occupations.

4. In which duty would tend to restrict the career development of commissioned officers.

5. That require the continuous or repetitive assignment of technically qualified personnel.

6. That do not require command of tactical units.

7. For which a valid organizational requirement exists.

8. That are not assistant positions to commissioned officer positions and that do not require the same type of skill and knowledge as do the latter.

9. That do not involve the command of a company or higher level unit, serving as company executive officer, serving as motor officer, or serving as staff officer or assistant staff officer of a unit staff.

Considering the main purpose of the program, the problems with which it has had to contend, the close control under which it must operate, and the fact that it embraces an entire personnel system, its essential elements and character are perhaps best revealed by actual quotations from the Army Regulations that govern it.

As an individual, the warrant officer is defined as follows:

A Warrant Officer is an Officer appointed, by warrant, by the Secretary of the Army and vested with limited powers. His rank and precedence are below those of a second lieutenant but above those of a cadet.

The occupational status of the warrant officer is defined as follows:

The warrant officer is a highly skilled technician who is provided to fill those positions above the enlisted level which are too specialized in scope to permit the effective development and continued utilization of a broadly trained, branch-qualified commissioned officer.

A technician is defined as follows:

The word "Technician" as applied to a warrant officer connotes the possession and exercise of technical skill, as opposed to tactical skill, and the ability to supervise enlisted personnel who are qualified in technical occupations similar to those of the warrant officer.

The following are examples of warrant officer positions:

BALLISTIC METEOROLOGY SECTION CHIEF

FIRE CONTROL REPAIR DETACHMENT CHIEF

RADAR REPAIR PLATOON LEADER

MISSILE SYSTEM (NIKE) REPAIR TEAM CHIEF

ORDNANCE SERVICE SHOP CHIEF

CHIEF MARINE ENGINEER

CRYPTOGRAPHIC UNIT CHIEF

Space precludes an explanation of the new warrant officer MOS structure. Yet, it is desirable to have some knowledge of its more significant elements before listing and discussing MOS. The MOS structure is very closely related to the enlisted structure because the enlisted area is the primary source of personnel input into the Warrant Officer Corps. The warrant officer MOS structure has five digits, or characters, with a letter being used in the fourth position of the code. The structure is illustrated in Table 1.

Table 1
Illustration of the 5-Digit Warrant Officer Military Occupational Specialty (MOS) Code

1st Character	2nd Character	3rd Character	4th Character	Suffix Digit
OCCUPATIONAL AREA (Digit)				
OCCUPATIONAL GROUP (Digit)				
MILITARY OCCUPATION (Digit)				
MILITARY OCCUPATIONAL SPECIALTY (MOS) (Letter)				Special Qualification (Digit)

EXAMPLE:

2 . . . . . Electronics.
22 . . . . . Air Defense Electronics Maintenance.
222 . . . . . Air Defense Missile Fire Control Technician.
222B . . . . . Air Defense Missile Fire Control Technician, Nike.
222B8. . . . . Air Defense Missile Fire Control Technician, Nike, Instructor Qualified.

Following are examples of warrant officer MOS:

202A Medical Equipment Repair Technician
214B FA Missile System Technician, Redstone
241C FA Missile System Repair Technician, Corporal
262A Nuclear Weapons Maintenance Technician
281A Radio Repair Technician
301A Data Processing Equipment Repair Technician
421A Armament Repair Technician
561A Master or Mate
632A Automotive Repair Technician
711A Unit Personnel Technician
811A Photomapping Technician
951A Criminal Investigator
031A Bandmaster
941A Food Service Technician
961A Army Attache Technical Assistant

Table 2 shows a comparison of commissioned officer, warrant officer, and enlisted MOS.

Table 2
Comparison of Commissioned Officer, Warrant Officer, and Enlisted MOS

Commissioned Officer MOS	Warrant Officer MOS	Enlisted MOS
7915 TOPO ENGINEER	811A PHOTOMAPPING TECHNICIAN	810 General Draftsman 811 Construction Draftsman 812 Map Compiler 813 Cartographic Draftsman 814 Illustrator 815 Model Maker
	812A SURVEY TECHNICIAN	820 Rodman & Tapeman 821 Construction Surveyor 822 Topo Surveyor 823 Topo Computer
	831 MAP REPRODUCTION TECHNICIAN	830 Printer's Helper 831 Compositor 832 Letter Pressman 833 Process Photographer 834 Platemaker 835 Offset Pressman 836 Photolithography Supervisor

Here, the commissioned officer MOS requires both professional level qualifications and command ability. Commissioned officer MOS 7915 is used to classify unit commander positions. In the case of a Topographic Company, this MOS would be used to classify the position of company commander (captain) and the position of company executive officer (lieutenant). Each of the warrant officer MOS would be used to classify the position of platoon leader at the head of each of the three platoons. Related enlisted MOS indicate the degree of specialization at the enlisted level as compared to that at the Warrant Officer level. These MOS and the company level unit reflect the problem encountered early in the development of the program in establishing the warrant officer position at a separate, or intermediate, level. Here, the platoon leader must be either a warrant officer or a lieutenant, and no position can be added. There is no room for both.

In summary, I have tried to present here a picture of what the warrant officer is under the Army's new program and why. From the standpoint of purpose and intent, the new program has tried to make of the Warrant Officer Corps a separate category of personnel. In so doing, however, it has extended utilization of the warrant officer so far into the area of complex technical equipment that it has virtually turned him into a technician similar to the industrial type technician in the process. Compared to the industrial technician, the warrant officer has comparable qualifications; in terms of relative rank he occupies the same intermediate level; but in terms of duties performed he more nearly approximates the Army's commissioned officer because he exercises supervision in almost all assignments. Generally, it would appear that the warrant officer approximates the civilian technician to a surprising degree, but perhaps both can be considered identical only to the extent that each has evolved in response to the same general technological progress and its separate effect upon their respective realms of endeavor.

SOME CONTRIBUTIONS OF TRAINING RESEARCH TO THE PERSONNEL-SYSTEMS CONCEPT

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INTRODUCTION

There is, I believe, rather general agreement today that a man-machine system usually possesses these characteristics:

- equipment (hardware),
- operated and maintained by people,
- tied together by a communication network,
- capable of operating as a more or less self-sufficient unit,
- for one or more designated purposes.

It would follow from this listing that a military man-machine system could vary greatly in complexity. For example, it could range from a single man with a tracking stick pursuing a pip on a radar scope, to the entire defense establishment.

When we talk about a personnel system or personnel subsystem, we tend to concentrate primarily on the human components of the larger system. This thought leads me to state two truisms:

1. Human performance directed toward accomplishing some agreed upon goal (or goals) is the heart of a personnel system.

2. The ways in which we recruit people, measure their capabilities, train them for the tasks to be performed, assess their proficiency, and develop and sustain their motivation all are critical ingredients of a personnel system.

Our first concern in personnel-system research and operations is the determination of the purpose of the system, that is, the goal toward which system output is directed. Once this is determined the nature of desired performance becomes clearer, and the ways in which the system can be designed efficiently become more delimited. Those tasks which may best be performed by people are next identified, in qualitative and quantitative terms. These basic task data are drawn upon for such personnel-system elements as job structures, selection and classification tests, training courses and training devices, proficiency tests, and job aids. Personnel policies and procedures (such as pay, promotion, and career considerations) are, of course, also critical ingredients of the personnel system.

The Human Resources Research Office (HumRRO) has had the mission of conducting research and development in training, leadership, motivation, and man-weapon system analysis for the Army for over ten years. I have chosen to talk only about training contributions to the

personnel-systems concept I shall discuss three related areas of HumRRO research concentration and briefly mention two of many other areas in need of concentrated study.

The three training research contributions to the personnel-system concept are:

1. The beginnings of a technology of training.

2. A somewhat different approach to training military leaders.

3. Management and administration of the training establishment and the training process.

The two research areas which I feel are in great need of considerable further study are:

1. The formation and change of attitudes.

2. Measurement of personnel-system output.

SOME TRAINING RESEARCH CONTRIBUTIONS

A Technology of Training

By the middle of this year there will be at least four quite new major publications of material bearing directly on a technology of training. Incidentally, I use the term technology of training to mean that systematic body of facts and principles which bear upon the design, development, conduct, and continuous evaluation of a training program. At least two of these volumes were contractually and conceptually aided along the primrose path to publication by our hosts today, the Office of Naval Research. In chronological order of their appearance the the four books are:

1. "Education and Training Media," edited by Glen Finch, NAS-NRC Publication 789, 1960.

2. "Human Factors Methods for System Design," edited by John D. Folley, Jr., American Institute for Research (under ONR Contract Nonr-2700(00)).

3. "Psychological Principles in System Development," edited by Robert M. Gagne, Holt, Rinehart and Winston, 1962.

4. "Training Research and Education," edited by Robert Glaser, University of Pittsburgh Press, 1962.

Each of these volumes is made up of chapters by carefully selected experts and, therefore, they must be considered to be a prime source of information on training technology.

HumRRO has contributed to the development of this element of the personnel-system concept through research conducted in such diverse areas as rifle marksmanship, tank crew operation, land navigation, missile system operation, and electronic maintenance. We have developed an approach to training which, incidentally, has recently been operationally adopted by USCONARC, the Army's training command.

Figure 1 summarizes the steps HumRRO and at least eight major Army schools have found effective in systematically developing training programs. Admittedly, this figure illustrates an arbitrary schema. Whether there are two, seven, or seventeen blocks representing the functions shown here is immaterial. (Seven, you will remember, is a magic number to psychologists and other gambling types.) Two things should be noted about the figure:

1. The training process starts with an analysis of the system.

2. It then specifies six functions in a definite order.

Each function represented here is a broad area of training technology. Some functions we can perform quite well today, while others we perform somewhat primatively. Further research should refine the techniques and methods required in many of the seven functional blocks shown on the slide, thereby increasing the operational effectiveness of the technology.

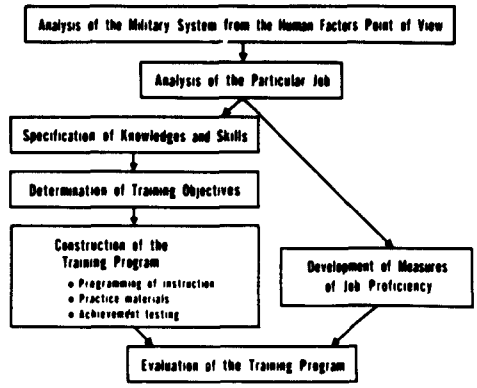


Fig. 1 - Steps in the development of training

The Training of Military Leaders

In one sense the second research area, the training of military leaders, is merely an example of training technology, but it deserves separate treatment for one special reason. The military leader must develop and sustain acceptable troop performance. His actions can markedly influence the effectiveness of the personnel system, for he is in most intimate and continuous contact with the men who comprise such a major part of the personnel system.

HumRRO has attacked leader training problems in several different research projects. In Task Offtrain, begun at the U.S. Army Leadership Human Research Unit in California and continued at the U.S. Army Infantry Human Research Unit at Fort Benning, Georgia, we have just completed a 16-hour block of leadership training lessons and materials which will be in operational use at over 250 senior ROTC courses this September, 1962. A bit of detail on this research task may be of interest to you.

The military problem confronting us was to give the junior officer practical experience in dealing with typical leadership situations prior to his actual assignment as a leader. By careful analysis of the military system in which junior leaders must operate, including detailed study of what effective and ineffective leaders actually did, we found that regardless of the situational variables involved, certain patterns of effective leader actions emerged. Thus the leader's functional role was defined. It consists of four major areas as shown in Fig. 2. While these areas should be elaborated in greater detail, let me just note that it is around this functional role that the actual training materials were based and a general scheme for teaching leadership was developed.

Figure 3 presents a scheme showing the flow of information, and also of social influence, which our research findings indicate is the essence of leadership. It is useful in aiding the leader to analyze the performance of his men. If their performance is superior, appropriate actions should be taken to reward it. If performance is unsatisfactory, some one or more of these corrective actions should follow.

Setting Platoon Goals and Standards

Motivating Performance

NCO Use and Support

Handling Disruptive Influences

Fig. 2 - The functional role of a platoon leader

The course uses specially prepared texts and taped skits, both of which are based on field findings. The taped skits serve as points of departure for small group discussions which follow the study of the functional role of the junior leader.

Since the Task Offtrain course is based on a factual study of effective leadership practice in the types of units for which the leader is being trained, it is designed for positive transfer of training to the leadership job in these units. The young officer with this course under his

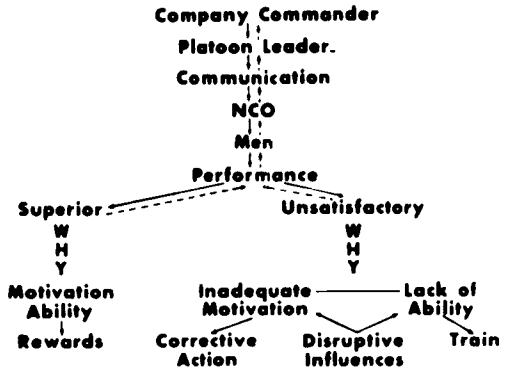


Fig. 3 - Analytical scheme for looking at leadership

belt will not be facing novel situations on his first assignment—he will be encountering situations he has solved before in the classroom.

This approach to leadership training is not novel. Practical exercises are traditional in military training. But the Task Offtrain research is based on system analysis and, further, it is solidly founded on a fact basis.

HumRRO is also developing and testing job description procedures and on-site junior officer training procedures in Task Samoff at the U.S. Army Air Defense Human Research Unit, Fort Bliss. One subtask of Task Samoff has as its goal the development of organized procedures for determining the objectives and subobjectives of the highly technical junior missile officer training courses.

In addition to these specific objectives toward which we are working by means of job questionnaires and on-site interviews (again we go to the field, to the system in operation, for this information), we hope for a more general methodological gain from this effort. In the course of the research a general scheme was developed for describing jobs which are nonrepetitive and flexible, and in which job objectives can be attained effectively in many ways. This technique for position description is being developed for use by enlisted military job analysts, and it may well prove to be a helpful addition to personnel and training technology. Neither the job description research nor the companion training research study have been reported as yet. However, both of these Task Samoff reports are expected early in FY 63.

The third leadership effort on which I wish to comment represents a joint personnel research and training research effort. The topic is NCO leadership preparatory training, and the research goal is to develop enlisted leaders as early as possible in their military career. The U.S. Army Personnel Research Office is developing the assessment devices for selection of potential leaders, and HumRRO is working on the course of instruction for the trainees who are new graduates of basic recruit training. The task code name is NCO.

Several earlier subtasks preceded the current version of the HumRRO course. NCO leadership training in the United States and overseas was first examined, and NCO job duties were defined based on tasks performed in the field. Then followed an extensive experimental investigation involving over 4000 squad members and 600 trainee leaders in which trainee aptitudes and interests, course length, kind and amount of cadre training, organization of content, and instructional methods were systematically evaluated.

At the beginning of the Army build-up late last summer, USCONARC asked HumRRO and USAPRO if the NCO research efforts could be implemented immediately to help reduce the already heavy trainor load at the Army Training Centers. Although the research was not then completed, selection procedures and a training course based both on that which was known and that which was strongly suspected were proposed and subsequently adopted. Implementation began in January 1962 and continues today at seven Army Training Centers. The course, incidentally, features both technical and interpersonal skills appropriate for the squad leader. It stresses practical application and is supported in part by a specially prepared NCO text book. Although the HumRRO course was initially developed for an infantry setting, it is largely composed of leadership functions which seem to have been readily integrated by NCO academy staffs into such other military specialties as armor, artillery, and engineers.

All three of these leadership training research efforts (Offtrain, Samoff, and NCO) share two common elements considered vital to the personnel-system concept:

1. They began by studying the military system in order to establish the job requirements for effective performance.

2. They developed the training required by the job requirements in order to assure performance capability.

The Management of Training

This is a relatively new area of research for HumRRO. By training management research I mean the determination of optimal administrative methods and procedures for organizing and running Army centers and schools. It embraces such topics as student and course scheduling, quality control of the student product, providing timely human factors information required in training and promoting positive job attitudes.

One example of such research is found in HumRRO Task Shockaction, which was done at the U.S. Army Armor Human Research Unit, Fort Knox. Four administrative procedures were incorporated in the experimental training course for armor crewmen in AIT:

1. Platoon scheduling. The training company was divided into four platoons who lived, went to school, and performed other duties together. This resulted in reducing the absences from class.

2. Formal provision for make-up and remedial training.

3. Increased emphasis upon and special recognition of the roles of the instructor and assistant instructor.

4. Provision for an adequate supply of training materiel (which, incidentally, did not increase the number of tanks needed and actually decreased the cost of ammunition and amount of gasoline required).

We are not sure of the specific effects of these administrative arrangements, but we strongly suspect they contributed to the overall effectiveness of the new Armor AIT program, which has been adopted by the U.S. Army Training Center, Armor.

A second example of training management research and development can be found in Task Upstream, one purpose of which is to develop and recommend for test systematic procedures for performing an analysis of complex man-weapon systems in order to assure the timely and accurate specification of training requirements. Such procedures have been compiled from the current practices and research findings in all three services and in industry, and a final report is now in the last stages of editorial review. The report includes the outline of a personnel-support-system research and development process, together with sample materials illustrating the desired products and administrative mechanisms for obtaining them.

A final example is Task Transition, being conducted at the U.S. Army Leadership Human Research Unit for the Army's Deputy Chief of Staff for Personnel. The purpose of this task is to identify and influence organizational factors that affect the civilian-military transition of Army recruits.

Early HumRRO research confirmed the findings of other service studies that the recruits' attitude toward the Army worsens in the first few weeks of service, and his interest in an Army career declines. The research also suggested, however, that certain administrative changes in reception processing and basic training procedures show promise both for improving attitudes and for more effectively achieving other Army training goals.

These research leads are being pursued. The first subtask of Transition is to investigate experimentally the effects on attitudes of the recruits' membership in training platoons made of various proportions of volunteers, draftees, and reservists. To date questionnaires have been completed by the trainees in 140 platoons. Aptitude and proficiency test scores will be added to these data.

Future work in Task Transition will concentrate more heavily on the development and test of techniques for more efficiently controlling and monitoring those activities within a command that are related to morale and motivation.

If the personnel system is to function smoothly and effectively, not only must we develop a better training technology, but we must also improve training management procedures in order to minimize interference with student learning and to foster the development and maintenance of favorable morale.

SOME NEEDED RESEARCH

Much, if not all, of the human factors research and development program of the Defense Department is directly or indirectly oriented toward developing a better understanding of some aspect of the personnel-system concept. Speaking personally, however, there are two areas about which I wish we knew a great deal more: attitude formation and change, and ways to assess the personnel subsystem influence on overall system performance. Of course, I may just be woefully uninformed in these areas.

Social psychologists know quite a bit about the correlates of various attitude measures. And, as in the area of task analysis, there are proven techniques available for measuring how people feel about certain matters. Some of the problems that worry me, however, go beyond this mere determination of what is the case. They represent a mixture of theoretical and practical issues. For example, how do we meaningfully classify the kinds of influences acting upon military personnel in order to study them experimentally? What is the relationship between measured attitude and the action actually taken in a given situation? Do soldiers really behave the way they say they will? How are interpersonal communication networks formed, and how does diffusion of information flow through them? How can positive or constructive predispositions to action be most effectively taught? How can the attitudes resulting from a policy statement or administrative pronouncement be more accurately predicted prior to its enunciation? How are favorable attitudes better maintained within the military organization? How can attitudes of the enlisted men and of the general public be made more favorable toward military careers?

The answers must come from a better understanding of individual and group behavior. We don't lack for effective communication media. We lack for understanding of what to say, when and to whom to say it, and most important of all, what actions to take in support of our words. We need a better understanding of how to relate personal needs and cultural factors to the personnel system.

This leads me to my second area of ignorance. How do we measure personnel system effectiveness? All sorts of indices are used singly and in combination: scores on operational readiness checks and technical proficiency tests; AWOL, VD, and reenlistment rates; range of radar pick-up; time scores to get under way, airborne or in position; and hits on target, circular error, and other measures of physical distance. Somehow this doesn't satisfy me. First, the numbers don't seem to tell me really how effective the system is. I also want to know the unique contribution of the human component. Second, I don't know how to combine meaningfully the masses of criterion measures which are available, assuming they do have some relevance to the performance so assessed.

Well, this is certainly not solely a human factors problem, but I hope more of us working in the area get more bright ideas and data soon.

SUMMARY

In this presentation I have described three areas in which HumRRO, working for the Department of the Army, has conducted training research which contributes to the personnel-system concept. They are:

1. the development of the beginnings of a technology of training

2. the training of military leaders

3. training management studies.

I have also suggested that, while there are many aspects of the personnel-system concept on which much more research and development effort is needed, the better understanding of how attitudes are formed and changed and how to measure system effectiveness clearly require more inspired and continuous study.

INTERACTION OF PERSONNEL SUBSYSTEMS-AN OPERATIONS RESEARCH APPROACH

Wallace J. Knetz

American Institute for Research

Three years ago, the American Institute for Research was asked to undertake a feasibility study of the gains which might be realized from an operations research study of the Navy Personnel System. It was believed that the continuing research studies, concerned with specific areas of interest within the system, might well be supplemented by a global approach to the working of the system as a whole. Operations research methodology offered a number of relatively new techniques which might be applied or adapted for this problem, and, in addition, provided a characteristic approach which had proven quite rewarding in the study of other types of military and industrial systems.

The system which may be dealt with in a system study cannot be rigidly identified by sets of rules or definitions, but it is, to a large extent, a matter of choice regarding the level of organization which is to be treated. Thus the personnel system is, if one wishes to climb higher on the organization chart, one of a number of subsystems within the entire Navy system. Yet it is sufficiently unitary in its nature and has enough complexity within its own relatively independent operation to warrant its study as a system in its own right. Translated, this means that we were in a position to conduct a system study which reflected the power level of our sponsor, the Chief of Naval Personnel. The products of the research, therefore, should be expected to contribute in two basic ways—first, in improved effectiveness of personnel system operation itself, and second, in the support of interactions of BuPers with the other Navy systems of bureau proportions. Before the end of this half-hour, I hope to demonstrate the potential which exists for substantial contributions in both areas.

The members of this audience certainly are well aware of the complex of needs which must be accommodated by a personnel system in one of our armed services. Permit me, however, to summarize the Navy problem. The basic need is to supply personnel at appropriate levels of skill for the operation and maintenance of our weapons systems, including those who operate and maintain the seagoing vehicles for these weapons systems, those who carry out the auxiliary functions of the Navy, and all of the people necessary to perform supporting services. This group must not only satisfy this year's needs, but must be in a suitable process of development so that the needs of future years will be met to the extent to which they may be forecasted. This development process includes certain self-sustaining functions as, for example, the continuing production of instructors and recruiters by means of which the system keeps itself alive. If we then define all such needs as the system's true requirements, we find that such true requirements must be adjusted to accommodate other realistic considerations. Personnel must be maintained in sufficient supply to permit a ratio of sea-duty to shore-duty time which will maintain morale, particularly in a Navy which encourages family life for its members. The number of accommodations possible aboard ship limits the degree to which true requirements may be met. And, of course, the annual personnel budget dictates a manning level which cannot be exceeded.

Beyond all of this, the personnel system should offer its members satisfying careers, with adequate opportunity for individual growth of accomplishment and reasonable expectations of advancement. The system must be sufficiently attractive to potential recruits so that the Navy will get its fair share of these people, in competition with the other armed services and with private employers.

Naturally, the system is unable to meet all of these needs perfectly. Values must be attached to competing needs in order to provide a basis for the compromises which are inevitable. Too often the results of these compromises may appear to be system failures when viewed narrowly in respect to one specific problem area. In general, through the years the system has tended to work well. Present-day management procedures have evolved so as to sustain this complex system's operation. Therefore, we believe that the zealous researcher should approach a system such as this with respect and with a considerable degree of caution. Radical changes of procedures, billed as reforms, could have disastrous effects if not grounded on a thorough understanding of the entire system structure and dynamics. There exists in this system complexity, however, a rich grazing area for the zealous researcher and a considerable amount of challenge in the development of subtle methods which can improve certain aspects of the system's effectiveness under present conditions and assist it in the growth and adjustment necessary for future demands.

In the early phases of this study, Dr. Richard Gaylord, of the American Institute for Research, and his associates developed a conceptual model of the personnel system, identifying a number of functional subsystems which operate semi-independently within the overall system structure. Each of these subsystems, such as training, classification, and distribution, was found to have its own system of values and its own set of subgoals—all of them in support of system goals, but not necessarily compatible with each other. This is quite understandable, for as I mentioned earlier, various of the needs of the system are in conflict with each other. Lines of communication exist between subsystems, and decision makers were found to be generally available in the system structure in order to resolve conflicts of subsystem interests.

It became obvious, however, that management decisions of this nature frequently were not supported by as much information on the implications of decision choices as could be made available, and that often such information could not be readily provided from existing data sources. The difficulty lay in the extent of the effect of many management decisions across the various subsystems and sometimes beyond the system itself. Such effects may be considered as a sequence of impacts of a personnel decision, the primary impacts being the most obvious and immediate, and secondary and tertiary impacts resulting from the earlier ones, moving out into the other subsystems and occurring later in time.

As an example, the training subsystem might decide to increase the length of missile technician schooling in order to include training on digital computers. This would have three primary impacts: first, the missile technicians would be better prepared for their jobs, so job effectiveness could be expected to be increased; second, there would be a transient reduction in missile technicians available for distribution; third, there would be a chronic reduction in missile technician availability since the increased training time would reduce the average time the technician would be available between graduation and separation. Secondary impacts would be found in the distribution subsystem. Missile technician billets would go unfilled or be filled with other ratings, first in accommodation to the transient undersupply, and later to the chronic reduction in supply. Further impacts would occur when the school quota would be increased by the training planner, in response to the increased course length. The increased flow of personnel through the school would require the training subsystem to increase school facilities. And so on. Conceptually, the impacts can be predicted largely on the basis of common sense. It is important that these impacts be determined quantitatively, however, for several reasons. Knowledge of actual amount of impacts permits the calculation of the amount of compensatory action to be taken and the appropriate timing of the action; also, frequently a theoretically predicted impact may be found to occur, but only to a neglible degree, so that it may be ignored.

The quantitative methods that have been employed in the estimation of these impacts suffer from some severe limitations: (a) they often require gross simplifications of the factors which are involved, for ease of calculation; (b) calculations, nevertheless, are often quite laborious and time consuming; (c) impacts of the higher orders are seldom estimated; (d) the effects of other transients already operating in the system are often overlooked; and (e) the methods are not readily adaptable to new types of decision problems.

It became evident to the research team that a mathematical model of the personnel system could be designed that would provide flexibility, accuracy, and extensive coverage of higher order impacts in the quantitative estimation of effects of personnel decisions. One complete model of this kind, operated on an electronic computer, could be made available for the use of decision makers in a number of the different subsystems, thus allowing them to concentrate upon the problem and its complete set of implications rather than to be mired down in a dreary routine of desk calculator punching.

Designs were prepared for a modest first try at a simulation model which would cover one of the sixty-odd enlisted ratings at one time, producing five-year projections of the personnel inventory within the rating under any specified set of personnel policies. This model was limited to the personnel production process.

The model, programmed for an IBM 705 Data Processing System, began its operation with a sample of personnel which represented the state of the rating at the beginning of the simulation period. This sample was drawn from the Enlisted Master Tape, a file in which a wide variety of data are kept current on every enlisted man on active duty in the Navy. Only certain kinds of information were coded for representation of the individuals within the model—e.g., those identifying characteristics which were needed for description of the inventory, such as rating, pay grade, and the NEC special skill classification codes, and other characteristics which had been found to influence the probability of the individual's passage from one state to another within the model, such as aptitude test scores, length of obligated service, time in grade, etc.

In the development of the model, it was necessary to identify the various meaningful states through which members of the sample might pass, and then to collect as much information as possible regarding the factors which influenced transitions between states in order that the simulation would faithfully reproduce the real situation.

The Electronics Technician rating was chosen as the single rating for which data would be collected on the pilot run of the model. Figure 1 shows a simplified pipeline diagram of the flow through this rating. The circles indicate major constraints which operate upon the flow through the line; the squares indicate major states within the rating. Thus, for entry into the "ET2 duty" state, one must normally advance from the "ET3 duty" state having (a) applied for the examination for advancement, (b) met the standards for taking the examination for advancement, (c) passed the examination, and (d) found an ET2 billet available.

The probabilities for advancement from state to state in the production process were determined to be functions of factors in two major classes, the directly and the indirectly controllable factors. They are shown in Table 1.

These are factors which were employed in the pilot model. Personnel decisions usually concern changes in one or more of the directly controllable factors. Frequently, the decision maker will have to be asked for his estimate of the effects of a policy to be tested upon the indirectly controllable factors, such as reenlistment rate. The model is not a product of clinical psychology, and cannot, on its own, estimate the motivational effects of policy changes! Projections of the model are made employing current levels of all factors, except those changes in factors which are to be tested. Monte Carlo methods of random selection are used extensively.

Figure 2 indicates graphically the results of an early run of the pilot model. The dashed line represents requirements, and the solid lines show the projection in terms of total electronics technician petty officers (a) with an extension of current policies, and (b) with the tested policy change.

In Fig. 3, the previous results for the policy change are stratified as to pay grade, chiefs on the bottom through third class, and strikers on the top. The shaded areas represent the number of petty officers or strikers who will have to serve in billets one grade higher than their own if all senior billets are to be filled. Two projections may be compared on the same stratified graph, as shown in Fig. 4. This method of summarizing results has been found to be a very effective aid to the interpretation of the projected tallies.

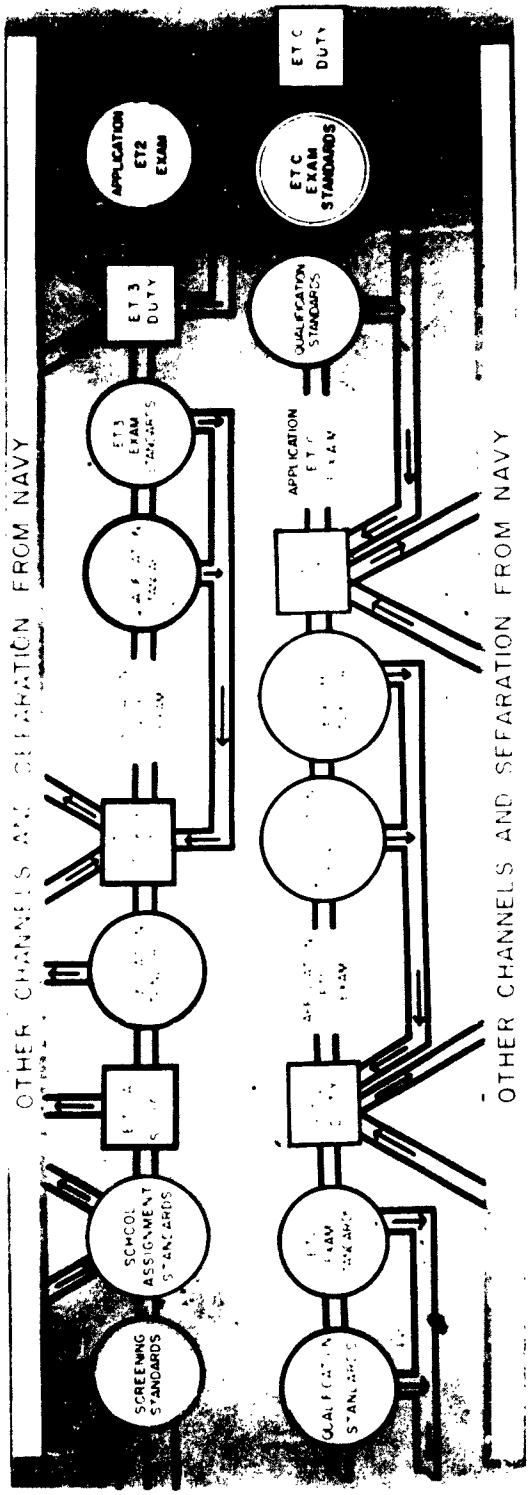


Fig. 1 - Simplified pipeline diagram of electronics technician production

Table 1
Factors Found to Influence Probabilities of Transitions from State to State

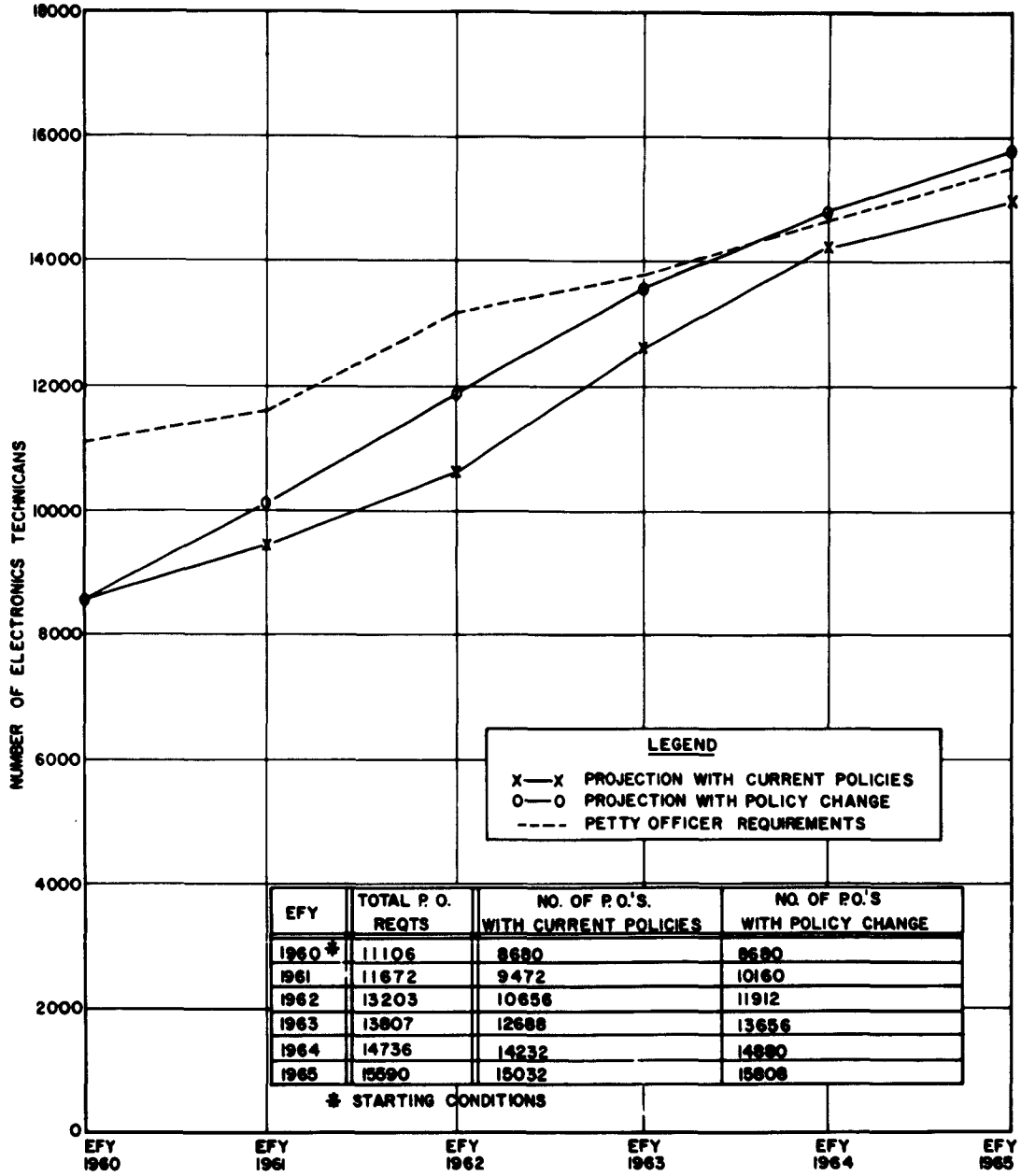
Directly Controllable Factors	Indirectly Controllable Factors
1. Recruiting Quota	1. Nature of Beginning Inventory
2. Potential Striker Assignment to Other Technical Ratings	2. Seasonal Variations in Annual Recruitment
3. Qualifications for Assignment to Class A School	3. USNR Voluntary Recalls
4. Class A School Quota	4. Attrition from Recruit, Trainee, and Operational Billets
5. Class A School Subspecialty Ratios	5. Reenlistment Rates
6. Duration of Formal Training	6. Percent of Eligibles Taking Advancement Examinations
7. Failure Rate from Class A School	7. Voluntary Retirement
8. Petty Officer Requirements	
9. Manning Levels	
10. Qualifications for Advancement	
11. Advancement Examination Cutting Scores	
12. Conversions Into and Out of Rating	
13. Service Qualifications for Retirement	

The program was also designed to report the state of the inventory at a greater level of detail. Figure 5 shows one of the many histogram projections that can be produced upon demand, to demonstrate trends in the distributions of obligated active service, length of service, time in grade, and career versus first-term totals.

A matrix of NEC skill classification codes versus pay grade is also reported for each year of the projection, together with listings of the corresponding requirements which were entered into the model at the start of the run. The program keeps track of the number of training man-years required during each year in order to attain the reported state of the inventory. Since the training man-years are readily convertible to training costs, dollar differences may thus be obtained for contrasted policy projections.

We have spent nearly a year on the development of a similar model which will have the capability of handling from one to all of the enlisted ratings simultaneously. This model is being programmed on the IBM 7080 computer, here in the Bureau of Naval Personnel. It is developing from a research subject into what promises to be a full-fledged operational tool.

Key planners within the Bureau of Naval Personnel have received a number of orientation lectures and have provided sample problems for our use in demonstrations. We are currently

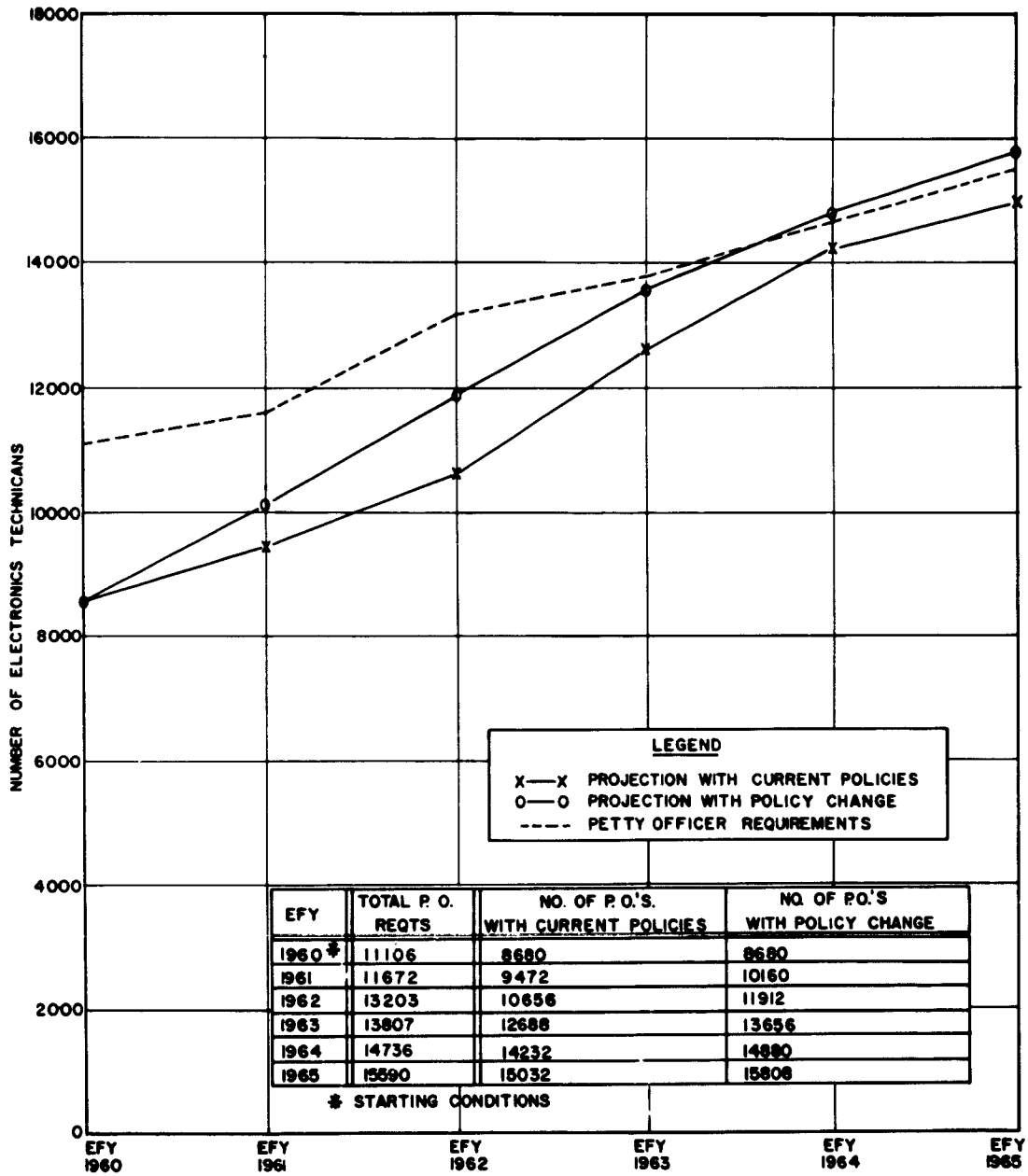


EFY	TOTAL P. O. REQTS	NO. OF P.O.'S. WITH CURRENT POLICIES	NO. OF P.O.'S WITH POLICY CHANGE
1960 *	11106	8680	8680
1961	11672	9472	10160
1962	13203	10656	11912
1963	13807	12688	13656
1964	14736	14232	14880
1965	15590	15032	15808

* STARTING CONDITIONS

1. UNDER CURRENT POLICIES (AND WITH NO REQUIREMENTS LIMITATIONS)
2. WITH POLICY CHANGE (AUTOMATIC SEMI-ANNUAL ADVANCEMENT TO ET3 OF ALL "A" SCHOOL GRADUATES, UPON MEETING TIME IN GRADE REQUIREMENTS)

Fig. 2 - Projected number of electronic technicians based on current and altered Navy policy



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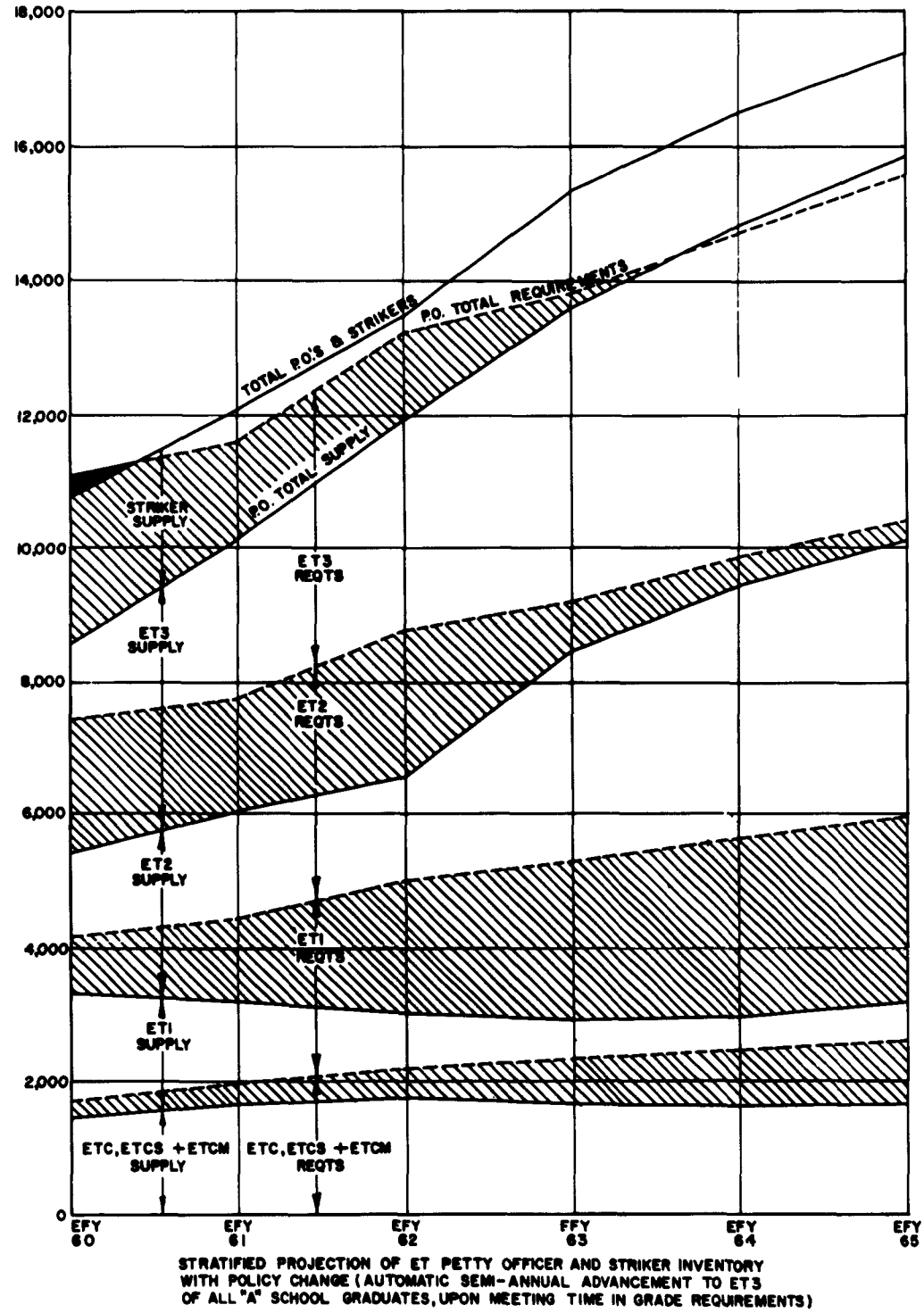

Fig. 3 - Stratified graph of projected results based on changed Navy policy

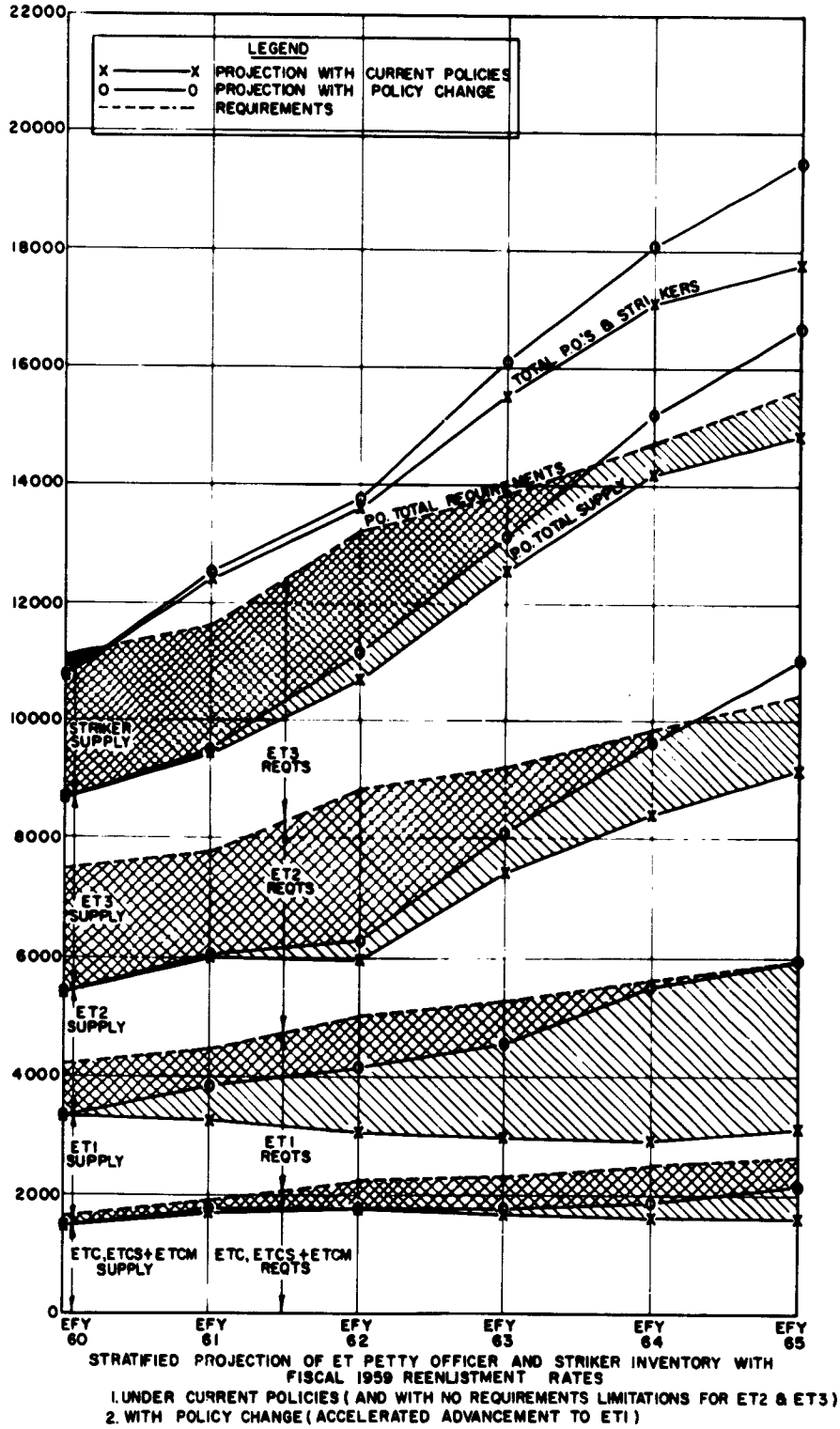

Fig. 4 - Stratified graph of the two projected results given in Fig. 2

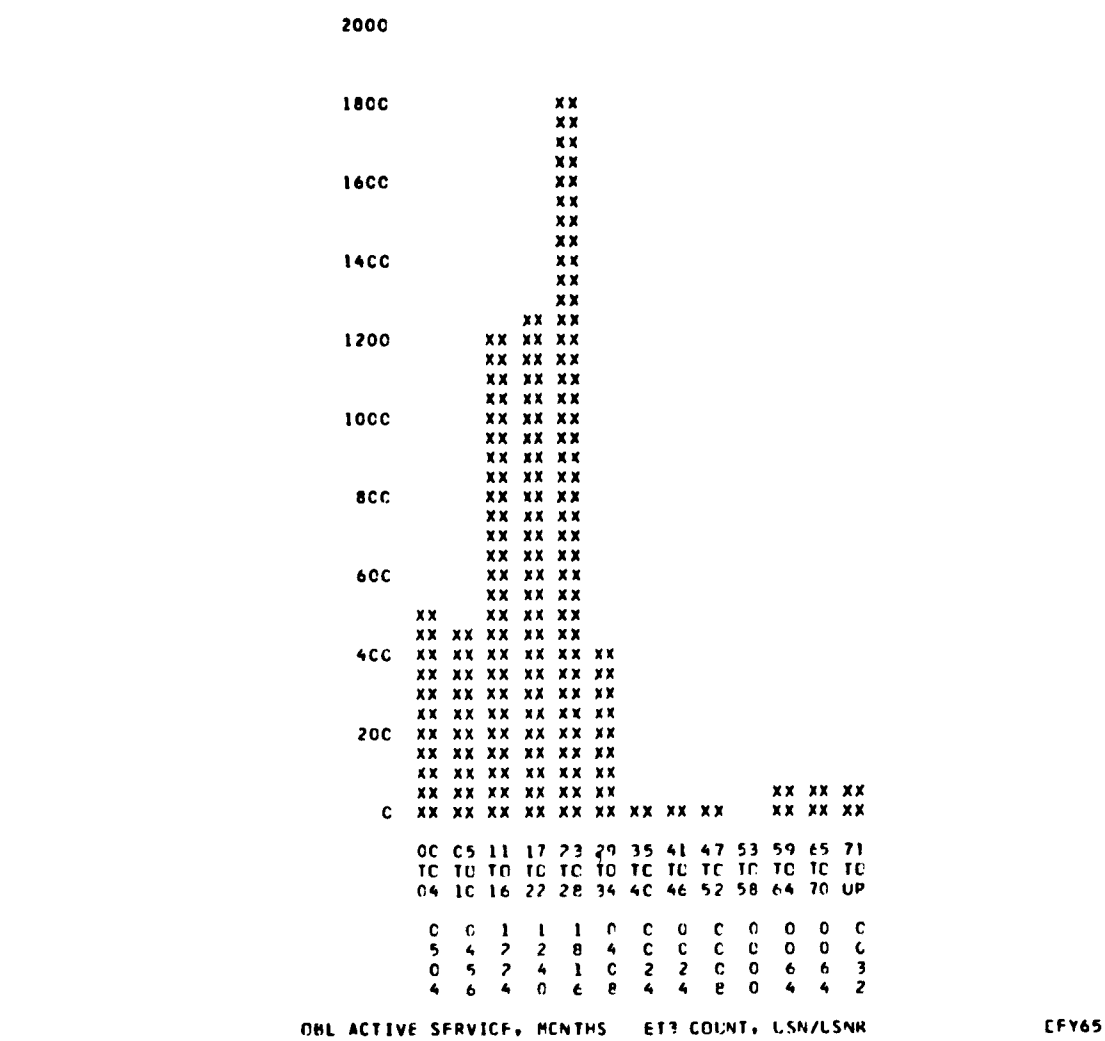

Fig. 5 - A typical histogram produced by the mathematical model

engaged in a series of working sessions with these planners in order that the soon-to-be-completed program will be as compatible as possible with their specific needs.

A handbook for management is being developed which will explain the utility of the model, its limitations, and the correct procedures to be employed when projections are requested.

Although the model was specifically developed as a means for intermittent tests of proposed changes in policy, there is reason to believe that it will contribute, on a routine basis, to the development of the periodic training and advancement plans.

We have also made arrangements for the training of bureau personnel who will have the responsibility for operating and maintaining the model after it becomes operational. Maintenance consists largely of annual updating of the transition coefficients, on the basis of the

previous year's indication of trends; the keeping current of the mathematical quantities and functions which represent "current policy"; validity checks and adjustments; and, of course, the annual drawing of starting samples from the Enlisted Master Tape. In support of this training, we shall develop a comprehensive operating and maintenance manual.

Having thus delivered for operational use the model of enlisted personnel production, we hope to extend the system study this coming year into the distribution subsystem area. With the projections obtained from the production model, we may assure ourselves that requirements are going to be met for men with some special skill at some future date. But, we do not know if they will be available to the particular fleet units which require them—they may be needed as instructors in support of the needs of a future period, or perhaps be assigned to other fleet units because of companion skills which have higher priority, or on a tour of shore duty because they threatened not to reenlist. We expect that the product of this distribution subsystem study will be an extension of the present production model. Some variation of linear programming will probably prove useful in the course of this work.

We are also interested in extending the costing features of the present model. At present, as has been explained, only the costs of training are capable of being estimated. The addition of a distribution dimension to the output inventories will allow estimation of the maintenance costs of personnel as well, so that estimates of the entire enlisted personnel budget may be derived.

The comprehensive projections which we are in the process of developing will be capable of contributing to the effectiveness of higher system interactions, that is, the interaction of the Bureau of Naval Personnel with the hardware and operations bureaus—optimization problems regarding the most effective mixes of men and machines—as, for example, the degree of modular maintenance which will minimize cost and yet remain within the feasibility range as regards the availability of men and materials. The present trends toward highly sophisticated weapons systems threatens to bring the personnel system to a saturation point. Major decisions will be needed when personnel problems become critical. More money? Yes, but should we spend toward the development of more easily maintainable equipment, with corresponding delays in the delivery of weapons systems? or into the personnel budget, and if so, toward incentive pay schemes, training aids, or reenlistment bonuses?

We believe that we have the modest beginnings of an executive information program which will assist Navy management in determining the answers to questions such as these and in such a fashion that the interests of the personnel system, and of Navy personnel themselves, will have adequate representation, and thus allow the system to respond effectively to the new challenges which lie ahead.

A MODIFIED APPROACH TO TRAINING REQUIREMENTS RESEARCH TO IMPROVE MOBILIZATION READINESS*

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U.S. Naval Personnel Research Activity
Bureau of Naval Personnel

INTRODUCTION

Distinguishing Features of the Approach

This report attempts to introduce research which the U. S. Naval Personnel Research Activity has been conducting during the past several months and will continue to conduct until the task is completed. The approach which has been used in this research is not new, but it is somewhat different from the usual research procedures because of the extent to which the following three concepts have been employed in the conduct of the research: (a) prescribing specific training to enhance the qualifications of Naval Reserve officers for specific mobilization assignments, (b) the systems concept, and (c) action research methodology. These three features, along with the factor of mobilization readiness, identify the subject with a theme concerned with approaches to personnel systems research in the military establishment.

The Systems Concept

Education, business, government, and the military establishment have for the past several years increasingly stressed an organismic conception of their activity—reflected in the basic works of Von Bertalanffy (1), Goldstein (2), and Allport (3), and in certain aspects of gestalt psychology founded by Wertheimer (4), Koffa (5), and Lewin (6)--a concept which views the total, integrated, relatedness and unity of objects, events, behavior, operations, and the like.

A system is regarded as a set of objects which are the parts of the system, and relationships exist among the objects and their attributes which tie the system together. In other words, the elements of a system are interconnected and interdependent and continue to operate together according to certain laws and in such a way as to produce some characteristic total effect. The system concept recognizes the unity and interrelationship of the elements of objects, events, behavior, operations, or an organization. Examples of discussions of the systems theory in relation to physical science, social sciences, behavorial science, administration, and learning are noted in the writings of Hall and Fagen (7), Meadows (8), Hearn (9), Miller (10), and Griffiths (11).

Education and training research often involve problems related to such factors as selection, classification, distribution, and utilization of personnel; medical, psychological, social, or other special technical areas; the occupation or profession for which the people are being trained; and the equipment which they will be required to operate. Training research methodology and results must, therefore, reflect a consideration of the interrelationships of these

*This paper is presented for information purposes only. It is based on research being conducted and implemented for the Chief of Naval Personnel. Aspects of the paper concerned with policy considerations and procedural factors shall be governed by the official publications representing the results of the research.

factors, as well as the relationships of the elements of each factor as parts of a total system with which the research is concerned. The systems concept does not imply that interaction and unity must be achieved through the design of a master organization which encompass all factors that are concerned with people. An important consideration in education and training research is the recognition of the contribution of each factor to the solution of the training problem and the necessity for cooperation in the research effort by personnel associated with the organizations which are concerned with the several factors of the system—cooperation at times to the extent that many persons who are concerned with the results of the research are actively engaged in the research. This procedure has been identified as action research.

Action Research

Evidence has indicated that much of the published information resulting from traditional research in the field of civilian education and training has had a disappointing effect on practice. This lack of use of the results of research is no doubt applicable to the military establishment. It is believed that members of military staffs, and civilian supervisors and executives, would make better decisions and engage in more effective practice if they would conduct research as a basis for decisions and actions, or could become more actively involved in research which is designed to influence their decisions and actions.

The process by which operating personnel study their problems scientifically in order to guide, correct, and evaluate decisions and actions is what has been called action research. The term was used in Lewin's (6) system of psychology in relation to his interest in social psychology and group dynamics. Collier (12) and Wrightstone (13) have used the term action research, while others such as Herrick (14) have used the term cooperative study or cooperative research. Action research emphasizes (a) that learning is more likely to change behavior when a person himself tries to improve a situation that makes a difference to him, (b) that the value of research applied to operations is determined primarily by the extent to which findings lead to improvement in practice, and (c) active participation in the research by persons who have the responsibility for implementation of results of the research.

Need for Research on Mobilization Readiness

A directive of the Department of Defense (15), and instructions and reports of The Secretary of the Navy (16) (17), and of The Chief of Naval Operations (18) (19), have stressed the need for the preparation of Reserve components on the basis of mobilization requirements; professionalization of active duty for training; evaluation of reserve training programs; the focus of reserve training on mobilization needs, mobilization potential of reservists, and operational readiness; development of specific training programs, curriculum materials, and specific active duty for training to insure continuity of training; standards and selection criteria based on mobilization requirements; and reflecting Reserve training in qualifications. A research task was, therefore, initiated to meet the need for (a) an appraisal of the present Naval Reserve training programs and, if necessary, to design a new program for each sponsored Naval Reserve component—a program in which the mission, content, and method of implementation will be focused on the qualification of inactive Naval Reserve officers for mobilization assignments, as well as on promotion and retirement; (b) a method of judging the contribution of Naval Reserve training to qualifications of inactive reserve officers; and (c) recognizing this contribution in their qualification codes and mobilization assignments.

THE PROBLEM

The problem in this research was to establish training criteria and procedures to (a) judge the contribution of Naval Reserve training to the qualifications of inactive reserve officers, so that this contribution may be included in (1.) the assignment of qualification codes (NOBCs) to these officers and (2.) the assignment of these officers to mobilization billets identified by NOBCs; (b) verify and enhance, through appropriate Naval Reserve training, the qualifications of inactive Naval Reserve officers for their present mobilization assignments; and (c) assure

that qualifications thus gained and recorded will be utilized when the Reserve officers are called to active duty.

The purpose of the research, therefore, is to provide The Chief of Naval Personnel with a method of identifying and coding qualifications gained as a result of Naval Reserve training so that the maximum potential of inactive Naval Reserve officers may be utilized in the event of their recall to active duty or mobilization.

APPROACH

Support

The research has been conducted under the sponsorship of the Assistant Chief of Naval Reserve and Naval District Affairs, Bureau of Naval Personnel, and with the active support of the Assistant Chief of Naval Operations (Naval Reserve).

Scope of Operations Involved

The research has been concerned with several kinds of personnel and training problems, such as establishment of mobilization requirements; appraisal of training programs, including analysis of the content of curricula and courses, and validation of the total program in terms of objectives; redesign of training programs, including construction of new curricula and new courses of study; arranging with naval commands to conduct the training; establishment of training criteria; and revision of classification procedures needed to implement the results of the research.

People Involved

Research which has been concerned with these several kinds of operations has necessarily involved people who have the responsibility for the implementation of policies and procedures which govern the operations. This condition, therefore, has not only required a close working relationship between the research specialists of the U.S. Naval Personnel Research Activity and the officers and civilian personnel who are responsible for these operations, but it has also required the active participation of the operating personnel in the research, especially staff members of the sponsors of Naval Reserve programs.

Action Research

Action research methodology was employed in the initial phase of the research in which a manual was published for one sponsored Naval Reserve program (20). In this phase the Personnel Research Activity assumed the major responsibility for determining research techniques, analysis of the training program, and publication of the results of the research. The sponsor of the Naval Reserve program, cognizant Navy commands, and/or divisions of the Bureau of Naval Personnel assumed an active role in establishing mobilization requirements and the training criteria and in perfecting classification procedures.

After publication of the results of the research for one Naval Reserve program, the research was extended to include the twenty-one selected reserve programs and the nineteen specialist reserve programs. This required the initiation of thirty-seven additional projects which will require thirty-seven publications representing the results of the research. The action research approach has been extended so that each sponsor of Naval Reserve programs will conduct the research under the general guidance of research personnel of the Naval Personnel Research Activity. Two steps were then taken to assist sponsors in initiating the research for their program. First, a set of general instructions on conducting the research was published and distributed to each sponsor. Second, the instructions were presented and discussed by representatives of the Naval Personnel Research Activity at a conference attended

by representatives of program sponsors. At the present time the Naval Personnel Research Activity is assuming the role of coordinator and consultant in the research, and the sponsor of each Naval Reserve program is conducting the research for his program. Final review and publication of the results of each project will be accomplished by the Naval Personnel Research Activity.

PROCEDURE

Focus of Research

The central concern in planning the research technique was to establish a procedure that would satisfy two conditions: (a) consideration of the adequacy of Naval Reserve training programs to qualify reserve officers for specific mobilization billets, and (b) an end-product result that could be used to determine the contribution of these training programs to the qualification of reserve officers for identified mobilization billets. It was found that procedures consisting of the following four major steps would satisfy the above two conditions: (a) identification of mobilization billets, (b) design of a Naval Reserve training program that will qualify reserve officers for the identified mobilization billets, (c) construction of training criteria by which the contribution of Naval Reserve training to qualification of reserve officers may be judged, and (d) the establishment of classification procedures which will insure that the qualifications gained as a result of completion of requirements of the training criteria will be considered in mobilization assignments of the reserve officers.

Identification of Mobilization Billets

The distinguishing feature of the approach used in this research was a change from an emphasis on training for a general military occupational area, training for general professional development, an opportunity for each officer to select his training from the four kinds of reserve training, and emphasis on promotion and retirement to an emphasis on training for mobilization readiness through a well-planned and designed training program, the portions of which are prescribed as requirements for the qualification of each reserve officer for a specific mobilization billet.

The first step therefore in the procedure used in the research was to identify the kinds of officer billets which members of a sponsored Naval Reserve program would be required to fill during the period of M + 3. This list of billets was derived from the officer personnel mobilization requirements of the sponsored reserve programs. Each officer billet was then identified with a four-digit code known in Navy circles as a Navy Officer Billet Classification (e.g., NOBC 3965, Personnel Officer).

Appraisal and Design of Training Program

The second step in procedures involved the construction of a reserve training program consisting of drill training, active duty for training (ACDUTRA), correspondence courses, and Naval Reserve officers' schools courses designed to qualify reserve officers for the identified mobilization billets. This procedure required (a) the appraisal—for a sponsored Reserve program—of the policies, pattern, and content of the total training program, the curricula and plans used as a basis for drill training, and the content and plans for active duty for training; (b) the construction (if necessary) of a new pattern of training, new training policies, new drill curricula, new active duty for training opportunities, a list of selected correspondence and NROS courses, and plans for the implementation of the total training program. Appraisal of the current training program was made by the cooperative efforts of the sponsor of the Naval Reserve program and training research specialists of the Personnel Research Activity. The final design of the program represent the combined efforts of the sponsor of the reserve program, training research specialists of the Personnel Research Activity, curriculum specialists of the Bureau of Naval Personnel, and Navy commands responsible for the conduct of the active duty for training area of the program.

Construction of Training Criteria

A crucial step in procedures involved the construction of training criteria by which the contribution of Naval Reserve training to qualification for mobilization readiness could be judged. The criteria consisted of (a) definite portions of the designed Naval Reserve training program--considered most directly related to the duties listed under each NOBC which identified mobilization billets--as the training required to enhance qualification for each billet, and (b) definite civilian and/or military background considered as prerequisites for complete qualification for each billet. Table 1 shows how a training criterion is constructed for one mobilization billet identified by the NOBC 3965.

Table 1
Sample of How a Training Criterion is Constructed for the Mobilization Billet Identified by the NOBC 3965

Designated Mobilization Billets and Sources of Training	Training Required by NOBC and Grade				
Mobilization Billets					
SUPPLY AND FISCAL FIELD 3965, Personnel Officer			3965		etc.
Code	LTJG LT	LCDR	CDR	CAPT	
Prerequisites required	P	P	P	P	
Sources of Training					
I. DRILL PERIOD TRAINING					
NavPers Curriculum					
A.	A	A	A	A	
B.			B	B	
C.				C	
II. ANNUAL TWO WEEKS ACDUTRA					
A. On-the-Job Training	A		A	A	
B. Courses, Exercises, Institutes, Seminars .					
1. Technical Area					
a.	a	a	(a)	(a)	
b.	b				
c.	c	c	c	c	
2. Special Area					
d.		d			
e.			e		
f.			f	f	
g.			g	g	
3. Line or Staff Corps Area		3		etc.	
III. CORRESPONDENCE AND NROS COURSES					
A. Correspondence and NROS Course Codes . . (See BuPers Inst. 1570.4)	C67 270 etc.	-B12 202 etc.	-A3 401 etc.	-A3 401 etc.	
Maximum years required to complete training prescribed for each NOBC and grade.	4	4	5	8	

The following criterion was used as a basis for the selection of the portions of the reserve training program as the requirement for qualification for a NOBC: (a) the training will enhance qualifications to perform the duties listed in the billet description for the NOBC, (b) the training is appropriate to the type and scope of the billet, (c) the training is appropriate to the level of responsibility which must be assumed by the grades designated for the billet, and (d) the mission, scope, and content of the training is characterized by a sequence which will provide progressively advanced training for the grades designated for the billet.

The training criteria were constructed by the combined efforts of Naval Reserve officers who were specialists in the field in which the mobilization billets are located and by training research specialists of the Naval Personnel Research Activity.

The training criteria serve as evidence of the contribution of Naval Reserve training to qualification for mobilization readiness. The validity of the criteria was established by prescribing the specific training which was considered by the officer and training specialists as the most valuable in enhancing reserve officers' qualifications for specific mobilization billets and which was selected from a program designed for the specific purpose of qualifying reserve officers for specific mobilization billets.

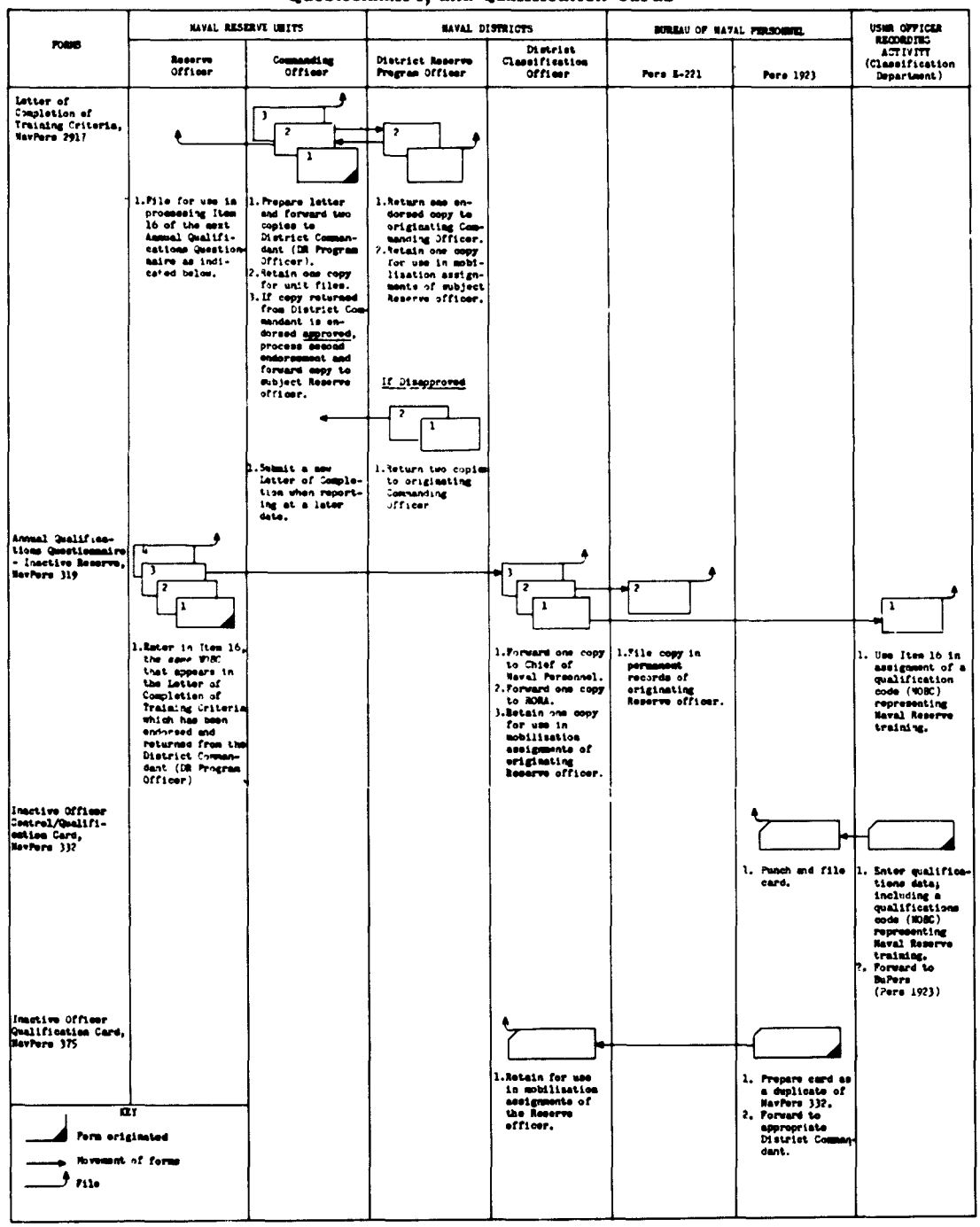
Reporting and Classification Procedures

The qualifications gained as a result of participation in a well-designed and effectively implemented Naval Reserve training program would stand the chance of not being recognized in the mobilization assignments of reserve officers in the event they are called to active duty, unless definite procedures were established for reporting qualifications gained and recognizing these qualifications in qualification codes and mobilization assignments of the officers. The final step in this research, therefore, was to establish procedures that would assure that this would be accomplished.

The classification procedures, which were perfected to assure that qualifications gained as a result of completion of the requirements of the training criteria will be reflected in mobilization assignments, consist of two steps: (a) a procedure for reporting to cognizant commands the completion of the requirements of the training criteria, and (b) a procedure for including in mobilization assignments the qualifications gained as a result of completion of the requirements of the criteria.

Reporting the completion of the requirements of the training criteria to the Bureau of Naval Personnel, appropriate Naval District, and the USNR Officer Recording Activity is accomplished by the use of a "Letter of Completion of Training Criteria," NavPers 2917, and the Annual Qualifications Questionnaire, NavPers 319. Evidence of completion of requirements of the criteria for a mobilization billet identified by an NOBC (e.g., NOBC 3965) is entered in these two forms and forwarded to cognizant commands as shown in Table 2. This evidence includes the NOBC for which the reserve officer has qualified as a result of completion of requirements of the training criteria for that NOBC. The evidence (including the NOBC) entered in the two forms, NavPers 2917 and NavPers 319, is used by the appropriate Naval District in the assignment of the reserve officer, who initiated the forms, to a mobilization billet or in judging the contribution of Naval Reserve training to his present mobilization assignment. To ensure that the NOBC becomes a part of the reserve officer's qualifications coding structure, the USNR Officer Recording Activity enters the NOBC in the Inactive Officer Control/Qualification Card, NavPers 332 (see Fig. 1), and forwards the card to the Bureau of Naval Personnel where a duplicate, NavPers 375 (see Fig. 2), is prepared and forwarded to the Naval District for use in connection with the two forms previously received (Table 2). NOBC 3965 thus becomes a qualification code which represents the qualifications gained as a result of participation in a Naval Reserve training program.

Table 2
Processing the Letter of Completion of Training Criteria, Annual Qualifications Questionnaire, and Qualification Cards



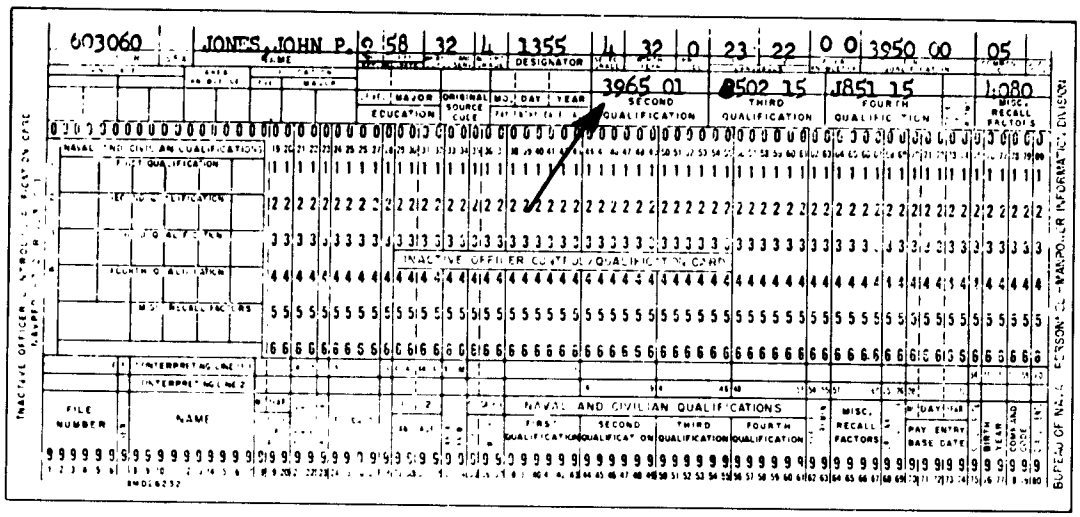


Fig. 1 - Sample of entry of qualification codes in the Inactive Officer Control/Qualification Card, NavPers 332

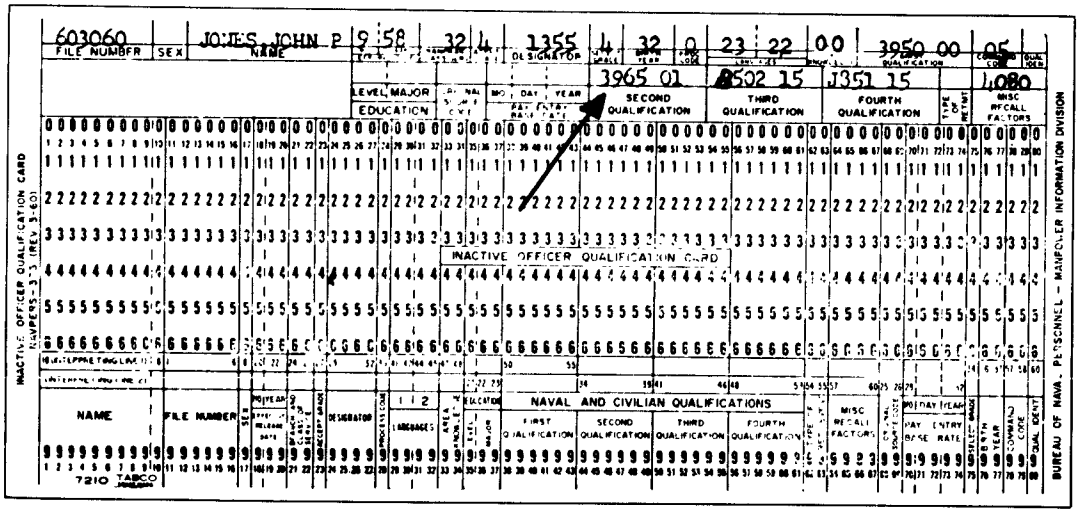


Fig. 2 - Sample of entry of qualification codes in the Inactive Officer Qualification Card, NavPers 375

RESULTS

Byproducts

The research described in this paper has not only resulted in the publication of training criteria and classification procedures for three Naval Reserve programs (20-22), and will result in similar publications for other programs, but it has also resulted in the following byproducts of the research because these tasks were performed in the process of producing the end product: (a) revival of a mobilization point of view toward Naval Reserve training, (b) establishment or review of the officer personnel mobilization requirements and identification of

mobilization billets of sponsored reserve components, (c) revision of the Manual of Navy Officer Billet Classifications, (d) appraisal of the current Naval Reserve training programs and redesigning of the programs to enhance the qualifications of reserve officers for their mobilization assignments, and (e) revision of classification procedures so that the qualifications gained as a result of completion of the requirements of the reserve training criteria will be reflected in mobilization assignments.

End Products

The research will result in a publication, for each sponsored Naval Reserve program, containing a Naval Reserve point of view, a list of mobilization billets, a Naval Reserve training program, training criteria, and classification procedures. Each publication will be used primarily by commands concerned with the implementation of the publication. These commands include the sponsor of a Naval Reserve program, Naval Reserve units associated with the program, the Bureau of Naval Personnel, Naval Districts, the USNR Officer Recording Activity, and naval commands that conduct the active duty for training prescribed in the publications.

CONCLUSIONS

The Approach to Training Research

No organized efforts have been made to determine the relative value of the approach used in this research to improve mobilization readiness of inactive Naval Reserve officers by prescribing specific reserve training to enhance their qualifications for specific mobilization billets, as compared with a more elective system in which reserve officers are allowed to select their training from a variety of opportunities offered under the four types of reserve training. However, contacts with commands responsible for the Naval Reserve program indicate that the latter approach has been too concerned with promotion and retirement, while the approach used in this research will not only satisfy requirements for promotion and retirement but will emphasize, to a greater degree, training for mobilization readiness. However, training for specific billets is not recommended as a concept that should be applied extensively to the training of officers on active duty (Regular Navy officers).

The solution to the problem in this research required a consideration, in addition to training, of several aspects of a total personnel system such as mobilization policies, needs, and procedures, Navy officer billet structure, classification policies and procedures, and utilization of officer personnel upon mobilization. All education and training research does not necessarily require the consideration of these aspects of a personnel system. However, when these aspects of personnel are involved in the problem, the end product of the research should reflect adequate consideration of them. The training aspect of the problem of the research described in this paper required a consideration of the interaction and interrelationships of many educational, psychological, social, military, political, and technical factors in the appraisal and design of appropriate training programs. The employment of the systems concept, which emphasizes thorough attention to the interrelationships of these factors, is mandatory in a search for a solution to most educational or training problems.

Two aspects of the problem led to the use of action research methodology. First, the problem involved several factors of a total personnel system and, second, the requirement that the results of the research be implemented. Constant contacts of Personnel Research Activity personnel with many naval activities and commands in the conduct of the research indicate an acceptance of the approach used in the research and an acceptance and willingness to implement the results of the research. This acceptance has been caused, no doubt, by the close association with, and in many instances active participation in, the ongoing procedures of the research by military and civilian personnel who have the responsibility for operations which will be effected by the results of the research.

The End Product

No organized attempt has been made to determine to what extent the training criteria and classification procedures which have been published for the three Naval Reserve programs (20-22) have been used as instruments to judge the contribution of Naval Reserve training to the qualification of members of these three programs for their mobilization assignments. However, contacts with naval activities and commands indicate that the increased interest stimulated by this research in the focus of Naval Reserve training on mobilization readiness, will result in full recognition of Naval Reserve training in mobilization assignments and in the use of the publications produced as a result of the research as instruments by which this will be accomplished.

FUTURE RESEARCH

The employment of the systems concept and action research methodology in this research has pointed up several areas of emphasis which could receive added attention in future education and training research in the Navy:

(a) A need for added emphasis on educational and training research concerned with the operational effectiveness of the total or a segment of Navy training. Research which considers the gestalt, the conceptual view of the total education or training process, and the interrelationships and interaction of its parts such as objectives, program, instruction, administration and management, and evaluation as they influence training effectiveness and operational readiness of personnel.

(b) A need for added emphasis on research concerned with the development of conceptual skill among officer personnel as well as technical skill and human skill (leadership).

(c) Recognition of the importance of the academic background and experience of research workers in the employment of the systems concept and action research methodology in education and training research. A background which should include academic foundations in educational, psychological, sociological, and philosophical disciplines. (Educational disciplines such as curriculum construction, instructional techniques, educational organization, administration, and management, and educational measurement and evaluation; psychological disciplines such as general psychology, educational psychology, and social psychology; sociological disciplines such as sociology, anthropology, and history; and philosophical disciplines such as philosophy of education and ethics.) Moreover, an extensive academic background and experience in group dynamics, research techniques, and military organization and operations provide the research worker with competences necessary for the successful employment of the systems concept and action research methodology in educational and training research in the military establishment.

BIBLIOGRAPHY

1. Von Bertalanffy, "An Outline of Systems Theory," Brit. J. Phil. Sci. 1:134-165 (1950)

2. Goldstein, K. [several works on the biological organism, 1918-1948]

3. Allport, F.H., "Theories of Perception and the Concept of Structure," New York: Wiley, 1955

4. Wertheimer, M., [gestalt concept] translation and condensation of 1923 article as "Laws of Organization in Perceptual Forms," in W.B. Ellis, "A Source Book in Gestalt Psychology," London: Kegan Paul Trench, Trubner and Co., Ltd., pp. 274-282 (1938)

5. Koffka, K., "Principles of Gestalt Psychology," New York: Harcourt, Brace, 1935

6. Lewin, K. [several works on vector, topological, conceptual, and field concepts of psychology related to behavorial and social sciences, 1917-1951]

7. Hall, A.D., and Fagen, R.E., "General Systems," Yearbook of the Society for Advancement of General Systems Theory

8. Meadows, P., "Models Systems and Science," Am. Sociol. Rev. 22 (No. 1): 3 (Feb. 1957)

9. Hearn, G., "Theory Building in Social Work," Toronto: University of Toronto Press, 1958

10. Miller, J.G., "Toward a General Theory for the Behavorial Sciences," Am. Psychologist 10:513-531 (1955)

11. Griffiths, D., "Administrative Theory," New York: Appleton Century, 1959

12. Collier, J., "United States Indian Administration as a Laboratory of Ethnic Relations," Social Res. 12:265-303 (May 1945)

13. Wrightstone, J.W., "Research-Action Programs for Research Bureaus," J. Educational Research, 42:623-629 (Apr. 1949)

14. Herrick, V.E., "The Survey Versus the Cooperative Study," Educational Administration and Supervision, 34:449-458 (Dec. 1948)

15. Department of Defense Directive No. 1100.4, "Guidance for Manpower Program, VII Reserve Forces," 20 August 1954

16. Department of the Navy, Naval Reserve, "A Report to the Secretary of the Navy by the Naval Reserve Evaluation Board (Johnson Board)," NREB1/jr, Serial No. 428, 2 August 1954

17. SECNAV INSTRUCTION 5000.6, "Guidance for Manpower Program," 26 August 1954

18. OPNAV INSTRUCTION 1001.72, with enclosures (1), (2), (3), "Instructions for the Organization, Administration, Training and Supplying of the Naval Reserve," 24 March 1961

19. OPNAV INSTRUCTION 5400.13 (series), with enclosures (1) through (5), "The Selected Reserve; policies and planning guidance for"

20. "Criteria for Coding Naval Reserve Officer Training (Supply Corps)," NavPers Manual 18586

21. "Criteria for Coding Naval Reserve Officer Training (Military Sea Transportation Service and Naval Control of Shipping Organization)," NavPers Manual 18612

22. "Criteria for Coding Naval Reserve Officer Training (Harbor Defense)," NavPers Manual 18616

23. BUPERS INSTRUCTION 1570.4 (series), with enclosures (1) through (7), "Training and Other Creditable Participation Approval for the Establishment of Professional Qualification for Promotion of Naval Reserve Officers not on Active Duty"

24. BUPERS INSTRUCTION 1571.1 (series), "Policy Concerning Active Duty for Training (ACDUTRA) of Reserve Officers and Enlisted Personnel"

25. BUPERS INSTRUCTION 1571.4 (effective edition), "Catalog of Active Duty for Training for Naval Reserve Personnel"

26. BUPERS INSTRUCTION 5400.1 (series), "Tables of Organization for the Naval Reserve"

27. BUPERS INSTRUCTION 5400.42 (series), "Selected Reserve Program of the Naval Reserve"

28. Executive Office of the Secretary of the Navy, Office of Analysis and Review, "Staff Studies of the Naval Reserve," 1958, 1959

29. Koffka, K., "The Growth of the Mind," trans. by R.M. Ogden, London: Kegan Paul Trench, Trubner and Co., 1924

30. OPNAV INSTRUCTION 100.2 (series), "Manpower Allocation/Requirements Plan MARP for Navy Military Manpower"

31. Wertheimer, M., "Productive Thinking," New York: Harper, 1945

USAF OCCUPATIONAL RESEARCH PROJECTS OF TRI-SERVICE INTEREST

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INTRODUCTION

As most of you know, the Personnel Research Laboratory's occupational structures research is conducted under Project 7734, which consists of four interrelated tasks:

1. The first task calls for the development of methods by which the Air Force can keep abreast of what airmen and officers do on the job. This includes working out methods for collecting job information—quantifying it, analyzing it, and reporting it to using agencies.

2. Under the second task we are asked to identify techniques by which the Air Force can better organize its work activities into jobs, specialties, and career or utilization fields.

3. The third task requires us to develop job evaluation procedures. That is, to develop methods for determining the appropriate pay and grade requirements for Air Force officer and airman jobs.

4. Finally, under the fourth task, we are asked to develop better ways for inferring and appraising the qualification requirements for Air Force jobs.

All these tasks call for the development of methodology, so it would be appropriate for me to discuss each one of them at this conference. However, I do not have sufficient time to cover our entire research program. What I propose to do, instead, is to report briefly on the current status of our work under each task and to discuss in considerable detail various applications of one of the methods coming out of this research project. This is a computer grouping technique which is helping us to solve many problems. I hope you will leave this conference with a clear concept of the way this method works, because it easily could have applications in your own areas of interest.

OCCUPATIONAL STRUCTURES RESEARCH: METHODOLOGICAL DEVELOPMENTS

Task-Inventory Procedure

Now, let me review the work on our first task, which requires us to develop methods by which the Air Force can keep up to date on what airmen and officers do on the job. We spent a full eighteen months on this task before we were sure which way to go. During this period we visited nearly every governmental agency which is concerned with job analysis. We studied the techniques used by these agencies and by industry. We reviewed the literature available on job analysis. We attempted to list and catalog the Air Force agencies that utilize job information and to analyze the purposes served by job data in each instance. Finally, we established a set of specifications to be met by an operational job analysis procedure which would best serve Air Force needs.

Our early investigations indicated that some type of task inventory was most likely to satisfy our requirements for a flexible, economical, and reasonably valid procedure to systematically collect, quantify, and organize information about Air Force jobs. We also felt that this procedure could be used to pinpoint special problems warranting more intensive follow-up by trained job analysts.

As most of you know, since that decision was made, our laboratory has conducted scores of studies concerning how task inventories should be constructed and administered, as well as how the resulting information should be organized and reported. I shall not discuss them in detail; however, I will state that there has been nothing in our research findings to date to discourage us from the task-inventory approach.

We have checked the quality of task survey information in many ways:

1. If a job incumbent fills out an inventory on two occasions, he will give us essentially the same information both times.

2. Supervisors agree to the reasonableness of information provided by their subordinates.

3. The information obtained by using more time-consuming daily work records agrees fairly well with information gathered with inventories.

4. When we slightly reword a task statement and list both versions in the same inventory, incumbents ordinarily give the same responses to both statements.

5. Low-level incumbents rarely check high-level tasks.

In summary, our experience so far leads us to believe we are getting job information of satisfactory quality.

Last year the Air Force officially adopted the task-inventory job-survey procedure when it published a revision of AFM 35-2. This manual specifies how job-analysis data will be collected to help maintain the Air Force occupational structures. The new AFM 35-2 procedures are straightforward. From information derived from the official specialty descriptions, Job Training Standards, and other available sources, an initial duty and task list for a career ladder is prepared and assembled in a standard format according to instructions given in the manual. At least two technical advisers assist in this initial construction phase in order to make the inventory as complete as possible and to insure proper use of technical terminology. The tentative inventory is sent to five or more Air Force bases, where other technical advisers modify or delete inappropriate statements and add missing duties and tasks which are known to be performed. The inventory then is revised, reproduced, and administered to samples of incumbents by local test-control officers all over the world.

Job incumbents routinely are asked to check those tasks which they perform as part of their jobs and to write in any pertinent unlisted tasks. They also are asked to indicate how their work time is distributed among the tasks they perform. On occasion they may be asked for other information relative to each task, such as (a) frequency of performance, (b) amount of supervision required or exercised, (c) time to perform the task, or (d) complexity or difficulty of the task. In each instance, the nature of such supplementary task information is dictated by the needs of the agency making the survey.

We know that information collected by task inventories will not adequately serve every Air Force need. One cannot plan a complete training course from task-inventory data. Inventory information, as it is normally collected, does not indicate the sequence in which tasks are performed. Neither does it indicate which tasks are performed alone and which ones are performed as a member of a team. A list of isolated tasks does not necessarily provide an integrated picture of a man's job. Nor do inventory data necessarily indicate an incumbent's proficiency. We do not know how well or badly a man does the tasks he marks. Furthermore, an incumbent may exaggerate his job, although so far we have not found this to be a serious problem.

On the other hand, the inventory approach has many advantages: (a) It is economical. Inventories can be inexpensively constructed and administered. Samples numbering in the thousands are feasible. (b) The inventory method is rapid. We normally allow only ten working days for administration of inventories after they have been received by the local bases. A 3000-case, worldwide sample can be obtained in about 30 days. (c) The inventory survey procedure yields information which is readily quantifiable. The data can be placed on magnetic tape to be organized and analyzed in many ways. (d) The inventory method is dynamic and self-correcting. Tasks included but not performed drop out; tasks omitted are written in. (e) The inventory method permits all kinds of sampling—by name, 100-percent, stratified, random, world-wide, or whatever. (f) The inventory method facilitates recall of work done by the incumbent. It identifies tasks for the nonverbal incumbent who might have difficulty telling an analyst what he does. (g) Finally, and probably most important, the inventory seems to be about the only way we can find to collect the masses of information required for managing a rapidly changing Air Force occupational structure. This becomes clear when one considers the necessity of identifying and describing job types, which will be discussed later in this report.

So far, we have constructed inventories for about 20 airman career ladders, and everything is running smoothly. In the coming year, we shall shift our emphasis to the officer area. By the end of next year, we hope our methods for constructing, administering, and reporting the results from officer inventories will be at least as good as those in the airman area today. At the same time, we feel that this is not the time to slacken our efforts in the airman area. Solutions still are needed for many problems concerning survey construction and review procedures, collation of write-ins, use of ratings, and, most important of all, analysis and reporting procedures. We have a strong desire to clean up these problems, stamp an approval on the procedures, and move on to other research areas. Unless we run into some unanticipated problems, we hope to reach this goal within the next couple of years. At that time, we anticipate that it should be feasible to survey all airman career ladders.

We are looking forward to that Utopian day when we shall have information available on magnetic tape concerning the tasks performed by 150,000 incumbents who have been selected so as to be representative of all Air Force specialties. It is our belief that analyses of such data would lead to many changes in the Air Force personnel system.

Procedures for Structuring Jobs, Specialties, and Occupational Areas

Let me move on now to our second research task, which asks us to develop methods by which the Air Force can group its work activities into jobs, specialties, and career or utilization fields. Actually this involves three separate research efforts. At the lowest level, the problems relate to the assembly of tasks into jobs. It isn't difficult to show the effect of job engineering on the utilization of talent. Currently, many Air Force jobs require personnel in the upper 20 percent of the national manpower pool. When one looks at these jobs, however, he gets the impression that a significant proportion of incumbent time is devoted to tasks which any well-motivated airman can learn to perform. We believe that the Air Force can save talent if the tasks that are assembled into jobs are homogeneous with respect to the level of talent they call for.

There is another type of task homogeneity which can influence talent and training requirements. If the first task assigned to a job requires mechanical ability, the second clerical ability, the third verbal ability, the fourth numerical facility, and so on, we shall need an all-around genius to fill the job. On the other hand, when jobs are relatively homogeneous with respect to the type of talent called for, that is, all the tasks in the first job are mechanical in nature, those in the second are numerical, those in the third clerical, and so on, it becomes a great deal easier to find and train an individual who can do the job.

I do not have time to discuss the small amount of job-engineering research we are doing at Personnel Research Laboratory. Nor will I take time to discuss our somewhat larger effort concerning the organization of specialties into career fields and utilization areas. Today, I shall limit my discussion to the Air Force specialty, which is at the second, and no doubt most important, level of the Air Force occupational structure.

The way that jobs are assembled into specialties is extremely important since the specialty is the basic unit used to manage the selection, classification, training, assignment, and rotation of Air Force personnel. Take reassignment, for example. Men are freely moved from one job to any other job that has the same specialty number. In a sense, then, management has built fences around similar jobs by using the specialty code to guide personnel actions. The average airman changes jobs about once every three years. When an airman changes jobs, a major cost to the Air Force is the amount of time required for him to reach the same level of proficiency in his new job as he had attained in the job from which he was transferred. If the jobs included in a specialty are not highly similar, then, the Air Force pays in two ways:

1. At any given moment, there will be large numbers of incumbents who have not reached proficiency in their current assignment.

2. The cost of on-the-job training becomes excessive. It becomes apparent, then, that specialties should be organized so that the cross-training time among jobs within specialties is minimized, that is, so that the Air Force pays the lowest price possible when airmen are rotated among jobs in their specialty areas.

Obviously, we cannot consider each individual job in the Air Force. Some specialties contain tens of thousands of incumbents, so it is inconceivable that we could compare the work performed by each man with that of every other man. However, any one specialty is likely to include many jobs which are, for practical purposes, identical. A morning-report clerk is a morning-report clerk, wherever you find him. But the specific duties of a morning-report clerk may be quite different from those of a test administrator or an airman pay clerk, even though all three of these individuals have the same specialty code. When a large number of individuals in a specialty are found to perform essentially the same work activities, we say that they are working in the same "job-type." Unfortunately, the job-types which exist in airman specialties have not been identified and described. This is true even in areas like personnel, from which I drew my examples. As a matter of fact, in a recent survey of personnel technicians, we received 93 different job titles from 113 incumbents. Many of these jobs may have been nearly identical, but no one can tell without studying the tasks the men perform.

Such considerations have led us to set three goals for the assembly of jobs within Air Force specialties:

1. In order to reduce the magnitude of the problem of assembling jobs within specialties, we want to develop a method for identifying and defining all the job-types which exist in the Air Force.

2. We want to develop some method for determining the cross-training times associated with movements among these job-types.

3. We want to develop a technique for assigning job-types to specialties in a manner which will minimize the average cross-training time among job-types within specialties so that the Air Force will pay the lowest price possible when airmen are rotated among the job-types in their respective specialty areas.

Today I want to discuss the first and the last of these goals since each of them involves an application of our computer grouping program. That is, I shall talk about how we intend to identify and describe job-types, and then I shall describe how we might group these job-types into specialties. Although I discussed our method for identifying job-types last year, let me review it for the benefit of those of you who were not at that meeting.

Job-Type Identification and Description—Suppose we have administered an inventory containing 500 task statements to 250 incumbents in a particular career ladder. We start out with 250 separate job descriptions, each of which perfectly describes the work time of one incumbent. Our goal is to group those individuals who have similar jobs so that we can describe the work-time of the 250 incumbents with a smaller number of job-type descriptions. In doing this, we want to make as little error as possible.

The grouping program does this for us in a stepwise fashion. The first step is to describe these 250 jobs as accurately as possible with 249 descriptions. This means that we must locate the two individuals who have the most similar jobs and develop one job description to replace their two separate descriptions. To find these two individuals we must compare each man with every other man. The computer actually makes these 31,125 comparisons, locates the two men having the most similar jobs, and develops the best single description to replace their two separate descriptions. We now can describe the 250 jobs as accurately as possible using 249 descriptions.

During the second step, we look for the best way to reduce the number of job descriptions from 249 to 248. The computer now considers the possibility of combining some third description with the first accepted pair and defining all three with a single description or, as an alternative, the union of another pair so that we end up with two composite descriptions, each describing two jobs. The choice is based upon a comparison of the errors, or loss of descriptive accuracy, associated with each of the 30,876 alternatives. Next, we consider each of the alternative ways the number of descriptions can be reduced from 248 to 247. This process is continued, until we have defined the 250 jobs as accurately as we can with every possible number of descriptions from 250 down to one. Furthermore, we know exactly how much error results from defining these 250 jobs with the best 249 descriptions, with the best 248 descriptions, and so on down to the point where we use one description to describe how these 250 incumbents spend their work time.

Of course, we cannot define all the jobs with a single description without making a very large error. We also may find that we cannot define the 250 jobs very well with 5, 10, or even 15 descriptions. It all depends on how many different types of jobs exist in the specialty area. We probably can define the work time of all morning-report clerks fairly well with one job-type description. We also might be able to define the work time of all test administrators or all airman pay clerks by using a single description in each instance. During the latter stages of the grouping process, however, when two of these job-types are forced together and defined with a single description, our error term will take a sharp rise. This helps us to determine the number of identifiable job-types in the career ladder. At this stage, we have the computer publish the best description for each job-type and tell us the location and description of the individuals in these job-types.

We had the conceptual solution to the job-type description problem eighteen months ago. Even now, however, the method is not ready for routine application to identify job-types. Two problems must be resolved. The search for solutions to these problems has taken much of our time this last year. The first problem has to do with the amount of computational labor involved. In the example I gave you, we began with a sample of only 250 job descriptions. Yet, we had to compute more than 31,000 composite descriptions and 31,000 error terms just to find the two men having the most similar jobs. To say the least, that is a lot of computing.

At the beginning of last year, the largest problem our machine program could handle was 240 cases. A problem of that size would have taken 128 computing hours—16 shifts of machine time. By the middle of the year, we could solve a 120-case problem in less than a day; and, soon after that, we actually solved a 240-case problem in 8 computing hours. Thus, by the end of the year, we were 16 times more efficient than we were at the beginning.

I am happy to report that at the present time we are working on a new program which should make it feasible to deal with 2000-case problems on the IBM 7090 computer. It probably will take another six months before this program is fully operational. If everything goes well, we shall be ready at that time to identify and define job-types in specialties about as fast as we can collect task-inventory information.

The second problem we have is to identify the most appropriate error term to be used in identifying job-types. The problem is to decide how best to define the "similarity" of jobs. As a result of our work on this problem, I now can give you several definitions, stated in rigid quantitative terms, each of which has special merits and weaknesses. I shall not attempt to explain what is involved in these alternative definitions of similarity because that would lead to some fairly complicated technical considerations. However, I shall try to indicate the nature of the problem in order to show you what I mean.

We could define the similarity of two jobs by the amount of overlapping work time. Under this definition, however, two jobs that involve identical tasks still could be classified as very much unlike. Suppose two jobs contained the same 50 tasks, but the first job required most of the incumbent's time be spent on the first 25 tasks, while the second job required most of the incumbent's time on the second 25 tasks. By definition, these jobs would not be similar, even though they involve exactly the same tasks. On the other hand, two jobs that have only 3 or 4 tasks in common on this inventory might be evaluated as quite similar according to this definition. This would be true when a large proportion of both incumbents' time was devoted to the same 3 or 4 tasks.

Similarity could also be defined by the number of tasks two jobs have in common. This is all very well until one asks "How similar are Jobs A and B when all the tasks in Job A are a part of Job B, but Job B contains a number of additional tasks?" Presumably an incumbent in Job B can perform Job A without additional training, but an incumbent in A might require extensive training before he could perform Job B. As a last point, you might note that it is not simply the number of overlapping or nonoverlapping tasks that determines similarity. Even a single nonoverlapping task would be a serious matter if that one task is highly complicated and critical to the mission of one of the jobs.

I mention these problems to indicate the complexity of establishing the best criterion for defining job-types. I should like to emphasize, however, that all these problems are independent of the computer program for grouping. This program will identify job-types according to any criterion we specify. Before leaving this topic, let me add that it may not make too much difference which criterion we settle on. So far, our studies indicate that we get almost the same results from any one of the criteria I have mentioned. By the end of this year, if all goes well, we should be able, on a routine basis, to identify and describe the job-types that now exist in airman and officer specialties.

Assignment of Job-Types to Specialties—Time does not permit me to discuss our approach to the problem of predicting the cross-training times between job-types. However, I should like to indicate how the grouping technique can be used to assign job-types to specialties once we have a matrix describing the cross-training times among job-types.

I stated earlier that specialties should be organized so that the cross-training time among job-types within specialties is minimized, that is, so that the Air Force pays the lowest price possible when airmen are rotated among the job-types in their specialty areas. Actually, this is an oversimplified statement. It leads to the conclusion that each specialty should include only one job-type, since this would make it possible to rotate airmen among jobs in their specialties without any cross-training. At present, however, the Air Force cannot manage the large number of specialties that would result, so the solution must be a compromise. The smaller the number of specialties, the easier management becomes. But the smaller the number of specialties, the more the Air Force must pay in terms of cross-training time as airmen are rotated. Thus, we have two problems: (a) to determine how many specialties there should be, and (b) to determine how job-types should be assembled into that number of specialties.

The grouping program is applicable to such problems. We start with a matrix of cross-training times among job-types and use the program to group these job-types into a fewer number of specialties. For any one of the possible groupings in this case, we assume that all airmen are reassigned at random to the job-types within their specialty. The error term used to evaluate alternative groupings is defined as the cost to the Air Force in terms of the total amount of time required for all airmen to reach proficiency in the job-types to which they are assigned. Before any grouping takes place, we assume that each specialty is composed of a single job-type. The error is zero, for each airman can be assigned only to his own job-type. The grouping operation proceeds in an iterative fashion, assigning the job-types into one less specialty at each step in a manner which minimizes the value of the error term.

At the first step, the number of specialties is reduced by one by grouping the two jobs involving the smallest cross-training time in a single specialty. This changes the value of the error term, since some airmen in this newly formed specialty have to crosstrain into a highly related, but different, job-type when personnel are rotated at random. At the second step, the

grouping procedure evaluates the error term for each of the alternative ways in which the number of specialties could be reduced by one. That alternative grouping is selected which grants the smallest value of the error term. The grouping procedure continues in this fashion to reduce the number of specialties, one by one, until finally all the job-types have been placed in a single specialty. Once the grouping is accomplished, the number of groups, or specialties, to be accepted for operational purposes can be decided by weighing the magnitude of the error term against the cost of management for each possible number of specialties.

Of course, what I have done is to describe an ideal situation. We do not anticipate any massive reorganization of the Air Force personnel structure. An exercise such as I have described, however, should yield suggestions for the reorganization of career ladders or career fields. Moreover, this example does give you a good illustration of how the grouping technique can be applied to minimize an error term.

For some time to come, the Air Force probably will have to reach decisions about changes in the occupational structure by its present method of estimating the overlap of qualifications requirements between a specialty in general and a job-type in particular. However, we believe that the routine identification of job-types will enable the Air Force to locate problems in the occupational structures before they become too serious. In addition, the descriptions of job-types will enable job analysts to make better inferences about the qualifications requirements for job-types and for specialties.

Job-Evaluation Procedures

Our third task, you will recall, is concerned with the development of methods by which the Air Force can determine the appropriate grade and pay levels for Air Force jobs. I gave a rather comprehensive review of our job-evaluation research program at our Tri-Service Conference last year. For this reason, I shall review this area of our work rather quickly today—even though we have accomplished more studies under this task than any other.

In 1954 the Air Force published a "Job Evaluation Scale." This scale contained ten factors which were selected after an extensive review of job evaluation plans used in industry and in government. These factors have been applied by the Air Force for many purposes. Several of the factors were used to rank-order specialties on the Air Force priority list for proficiency pay. They were used to evaluate airman career fields in order to group them into the Highly Technical, Technical, and Semitechnical categories. Later, these same data were used in prescribing the authorized distribution of skills and grades within these three categories. Some of the factors were applied to determine the appropriate officer-airman ratios for each Air Force occupational category. They have been used to determine whether certain jobs should be manned by airmen or by commissioned officers. They have been used in experimental studies to evaluate the accuracy of minimum aptitude requirements established for entry into airman specialties. Finally, they were used to determine the appropriate grade spread for each officer and airman specialty. There is no doubt about it. Job evaluation has had an important impact on the Air Force personnel system.

Last year I indicated how our research findings were used to develop the new job evaluation procedures described in the 1961 revision of Air Force Manual 35-2. Most of the changes we introduced were designed to improve the accuracy of rating procedures. We made only a few changes in the original factor definitions, and no changes were made in the weights to be used in computing the evaluation composite. Our studies had indicated that the factors in the Air Force job evaluation system were well chosen and representative of those used by industry to evaluate hourly paid jobs. However, there were indications that the inclusion of certain additional factors might improve the system for evaluating officer jobs. Since this same observation was made by the consultants at last year's Tri-Service Conference, we worked on this problem during the year. We now have a tentative set of factors which give increased consideration to the management, planning, decision-making, creative, communication, and judgmental skills which are so important for, and often peculiar to, officer-level jobs. We have programmed a whole series of studies which are designed to develop weights, scales, and definitions for these factors and to determine the adequacy of their coverage.

The ultimate goal for our job evaluation research is the development of procedures by which the Air Force can accurately evaluate every officer and airman job-type. We believe that if job evaluation takes place at the job-type level, the Air Force will be able to improve the quality of many of its management policies. To give one example, the Air Force currently authorizes more upper grades in career fields having high scores on job evaluation factors. This, in my judgment, is a good policy. However, the appropriate distribution of grades for a career field could be more accurately determined if, first, we defined all the job-types in the career field; next, determined the number of individuals working in each of these job-types; and, finally, determined the appropriate grade requirement for each job-type.

A few minutes ago I indicated how we will soon be in a position to begin identifying job-types using task-inventory information. We currently are working very hard to develop improved sets of factors, scales, and weights for use in evaluating these job-types. Before we can make much progress toward this goal, however, we must obtain an acceptable set of criterion values. We feel that our greatest need is for a representative set of officer and airman job-types for which there is universal agreement concerning pay and grade. Given such a set, we then could find the appropriate factors, scales, and weights to predict these criterion values.

About ten months ago we actually started out to establish some tentative criterion values. We soon ran into the question of whether we wanted to predict pay requirements or grade requirements. Job evaluation in industry has always been for the purpose of pay determination. Yet, with one exception, job evaluation in the Air Force has always been for the purpose of controlling grades. From one point of view this seems reasonable, since pay is tied to grade. But the concepts of grade and pay are certainly not synonymous. It seems entirely possible that some factors which are appropriate for determining pay are not appropriate for determining grade.

For several reasons, we judged that our best and safest approach would be to develop simultaneously a set of grade-criterion values and also a set of pay-criterion values for the same sample of job-types. About four months ago we conducted a preliminary study in which we submitted 144 officer job descriptions to two groups of officers attending the Air Force Command and Staff College. One officer group was instructed to rank-order the sample of 144 jobs in terms of deserved compensation—without regard for grade requirements. The second group was asked to rank-order these 144 jobs in terms of grade requirements—disregarding the level of compensation deserved. We found that certain jobs were ranked considerably higher on one list than on the other. The jobs that were higher on the pay-criterion list than on the grade-criterion list included certain aircrew jobs, such as helicopter pilot and radar intercept officer, and many of the scientific, engineering, and medical jobs. On the other hand, a number of staff jobs were ranked higher on the grade-criterion list. While these findings are based only on the opinions of a group of officers attending Command and Staff College, I think the implications are pretty obvious.

While we were at the Command and Staff College, we had other groups of officers rate the sample of 144 jobs on the job-evaluation factors now in operational use and also on some of the new factors being considered for use with officer jobs. I am pleased to report that we can predict either the pay-criterion values or the grade-criterion values with a fairly high degree of accuracy from our revised set of factors. The currently operational factors also predicted these criterion values fairly well—in spite of the fact that they may have a little less face validity for officer job requirements. In connection with this work, let me mention that we have an alternative method for determining factor weights. However, I shall wait to discuss this with the other applications of our computer grouping technique.

Procedures for Determining Qualification Requirements

In order to have more time to talk more about the grouping technique, I have elected not to discuss our fourth task today. This task requires us to develop methods for inferring and appraising the qualifications requirements for Air Force jobs. The acid test for any qualification requirement is whether or not incumbents who meet the requirement actually do better on the job than incumbents who do not meet the requirement. Hence, we have devoted some of

our research effort to the age-old problem of developing an acceptable measure of on-the-job proficiency. While I shall not go into our work on the qualification-inference problem, I shall use one of our criterion-development studies to illustrate an application of the computer grouping technique.

OTHER APPLICATIONS OF THE GROUPING TECHNIQUE

I have already indicated how we are using the grouping procedure to identify job-types and how we propose to use it to group job-types into specialties. There are, however, many other useful applications of the general computer program. To list a few examples, this procedure can be used to determine (a) which technical schools should be grouped in order to reduce the number of test composites in a personnel classification program, (b) how evaluation factors should be weighted together in order to establish appropriate grade and pay requirements for jobs, and (c) the appropriate composition of an on-the-job criterion composite. It also can be used to group individuals in terms of the similarity of their score profiles on a series of personality and aptitude tests. As a matter of fact, it was used recently to establish a taxonomy of Latin American tapioca plants. Finally, and this may be most important of all, we think it can be used to assist future boards of officers to reach closure and to state their recommendations in a more precise manner.

To understand and utilize the grouping method to advantage, we first must recognize that it ordinarily costs us something to group. When attempting to describe all the jobs in the Air Force with a limited number of job descriptions, we lose descriptive accuracy. As we group more and more job-types into specialties, we pay an increasing price in terms of the average time needed for incumbents to reach proficiency as they are rotated among the jobs within their specialties. If we attempt to predict the success of airmen in all technical training courses from a limited number of aptitude-test composites, we shall not do so well as we can from a separate test composite for each course. Therefore, we will lose predictive accuracy.

When we have a clear concept of what it is we want to avoid losing as a result of the grouping process—and after we have devised a method of quantitatively evaluating such loss as it occurs—the best way to group becomes obvious. For example, consider the problem of grouping technical training courses in order to reduce the number of test composites for a personnel classification program. There is no question about the best classification procedure. It involves use of a separate least-squares-weighted test composite for each course. Under this condition, we should do the best job of predicting the success of each airman in each course. The Air Force, however, cannot afford to compute and consider 150 separate test composites for each incoming airman. Thus, we want to reduce the criterion situations and test composites to a manageable number while retaining as much predictive efficiency as possible.

We begin with a separate regression formula for each course. Dr. Bottenberg, who is one of our statistical consultants, developed a method by which we can determine the overall predictive efficiency under this condition. We first attempt to reduce the number of test composites by computing the best single equation to simultaneously predict grades in Course 1 and Course 2, and then evaluate the resulting overall loss of predictive accuracy. Next, we develop a single equation to predict grades in Course 1 and Course 3. We continue in this manner until we have considered each of the $N(-1)/2$ alternative ways by which we can reduce the number of criterion situations and test composites by one. We accept that alternative which results in the smallest loss of predictive efficiency and move on to consider all the ways we could reduce the number of test composites by two. Our procedure is analogous to the one used to define job-types. Here, we are trying to avoid loss of predictive accuracy; with job-types, we were trying to avoid loss of descriptive accuracy.

Let me now illustrate how the grouping technique might be used to help a board of officers reach agreement. For purposes of discussion, we shall assume we are responsible for selecting the first class of cadets for the Air Force Academy. We have scores on 15 variables for each of 5000 applicants. A special board of 24 senior officers has been called together to decide how these variables should be weighted together in order to compute the selection composite. Since this is a new academy, criterion data are not available. However, each board

member is familiar with the curriculum to be offered and with the general characteristics of the selection variables.

This may seem to be a reasonable situation; but we have come to the conclusion recently that boards should not be asked to recommend weighting procedures. The effect of an applied weight is a highly complex matter which is influenced by several factors, including the standard deviations and intercorrelations among the selection variables. The board members' main concern should be to insure that, whatever weights are applied, the final selection composite will rank-order all 5000 applicants in the manner which is most acceptable to the board members. Rather than argue about the relative weights to be applied to selection tests, the board should restrict its attention to the relative acceptability of applicants with given profiles of scores on the selection tests.

This leads us to a new approach to board actions. The first step in this instance is to select a representative sample of academy applicants—150 cases would do nicely. Next, we prepare for each of these 150 applicants a printed card showing the individual's 15 selection test scores. Each board member is given a set of these cards and asked to study the score patterns and arrange them so as to show the ranking of the applicants in order of their acceptability. After we have collected the rank-order data, our first step is to develop a precise mathematical statement of each board member's rating policy. For each board member, we determine mathematically a set of weights which, if applied to the selection test scores, will line up the applicants in accordance with the board member's desires.

At this stage we have 24 mathematical equations which are the best expressions of the 24 officers' rating policies. We want now to develop a single mathematical formula, or set of weights, which best expresses the policy of the entire board. This is where the grouping technique is applicable. We begin by determining how well we can express the policies of the 24 board members using 24 separate equations—one for each rater. We should be able to determine this very closely if the individual board members are consistent in their rating behavior. Our first step is to compare each equation with every other equation in order to locate the two board members who are in closest agreement on the characteristics of applicants who should be accepted, that is, the two board members with the most homogeneous equations. Then we develop a single equation which best represents the joint policy of these two board members. In subsequent operations, the number of rater groups is systematically reduced, one by one, until all raters have been clustered within one group. At each step, the computer prints a statement of the overall predictive efficiency, as well as the equations that best represent the joint policy of all raters in each group at that stage.

If all the raters can be grouped within a single cluster with only minor loss of predictive efficiency, there is a high degree of agreement among board members concerning how the test scores should be weighted together in order to compute the selection composite. In this case, the board could be dismissed, for we would have captured their single policy. It is entirely possible, however, that more than one policy exists among the board members. In this event, the grouping technique will make a precise statement of what these differences of opinion are. Nevertheless, the board should not be asked to arbitrate differences in the weights assigned to the selection tests. Rather, the several policy equations are used to rank-order the applicant sample, and the board is asked to arbitrate differences in the rank positions of applicants that are disclosed. Once the board members have agreed upon a rank-ordering for the sample, it is a simple matter to determine the appropriate set of weights for the final selection composite. This is only one example of how the grouping technique can be used. But we should recognize it is a representative example.

The Air Force is constantly calling boards together to determine how variables should be weighted together for making decisions. Who should be promoted? What specialties should receive proficiency pay? Who should be given a regular commission? What officers should be given responsibility pay? The solution to any one of these problems involves either the implicit or explicit weighting together of factors judged to be relevant to stated goals. If these factors are made explicit, the grouping technique can help the board reach closure. Moreover, application of this technique results in a precise statement of the factors and weights to be used in carrying out the board's recommendations.

Earlier, I mentioned that we are planning to use the grouping technique to help define the composition of on-the-job criterion composites. This is a rather interesting application in that we are having supervisors rate simulated incumbents. As Dr. Carp likes to put it, "We're tired of being unable to predict 'real live' people, so we decided to create some of our own." We simulate incumbents by ascribing to them scores on factors that are hypothesized to be relevant to success in a particular specialty area. Then we ask supervisors to study these descriptions and arrive at a global evaluation of the worth or effectiveness of each simulated incumbent. We intend to apply the grouping technique in order to determine which factors should be weighted into the criterion composite for a particular specialty. This approach has an advantage in that it does not require field testing. It also enables us to include factors we do not yet know how to measure. The only requirement is that each factor be definable in terms that present unambiguous concepts to supervisors who must do the rating. We hope that this study will provide guidance for future criterion development.

As a last example of how the grouping technique can be applied to operational problems, I shall describe how we are using it to determine weights for job evaluation factors. By now you can probably outline steps that are necessary. We had a group of officers at Command and Staff College study the profiles of scores on our experimental job evaluation factors for a sample of officer jobs and rate these jobs on the basis of deserved pay. A second group studied the same score profiles and rated the jobs on deserved grade. You might be interested to learn that we were able to capture between 90 and 99 percent of the variance in these officers' individual ratings. In addition, the results of the grouping operation indicated there is a great deal of similarity in their policies concerning which factors and weights are appropriate for award of grade or pay.

I hope that my remarks have given you a general idea of the occupations structures research program being conducted by Personnel Research Laboratory. I trust that you can see how the results of this program can have an impact on the Air Force personnel system. Secondly, I hope that I have given you a clear concept of how our computer grouping technique works. We feel that this technique can be applied to many types of problems. Finally, I would like to call your attention to the Personnel Research Laboratory's published documentary reports, which present a more comprehensive overview of our research activities.

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BIBLIOGRAPHY

AF Manual 35-2, "Occupational Analysis Procedures for Surveying and Evaluating Air Force Specialties," Washington: Department of the Air Force, 1961

Bottenberg, R.A., and Christal, R.E., "An Iterative Technique for Clustering Criteria Which Retains Optimum Predictive Efficiency," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-61-30, Mar. 1961

Christal, R.E., "Occupational Analysis: One Route to Improved Selection Procedures and Better Utilization of Available Talent," in "Proceedings, Tri-Service Conference on Selection Research, May 1960," Washington: Office of Naval Research, ONR Symposium Report ACR-60, pp. 49-55

Christal, R.E., "The Use of Aptitude Tests in the Initial Classification of Air Force Military Personnel," in "Tri-Service Conference on Job Qualifications Analysis, February 1960," Washington: Office of Naval Research, ONR Symposium Report ACR-41, pp. 27-35

Christal, R.E., and Madden, J.M., "Effect of Degree of Familiarity in Job Evaluation," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-60-263, Nov. 1960

Christal, R.E., and Madden, J.M., "Air Force Research on Job Evaluation Procedures," in "Proceedings, Tri-Service Conference on The Role of Job Evaluation Techniques in the Structuring of Military Occupations, April 1961," Washington: Office of Naval Research, ONR Symposium Report ACR-71, pp. 25-33

Christal, R.E., Madden, J.M., and Harding, F.D., "Reliability of Job Evaluation Ratings as a Function of Number of Raters and Length of Job Descriptions," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-60-257, Oct. 1960

Cowan, G.E., "Development of Specialty Outlines for Collecting Job Information in the Radio-Radar Systems Career Field," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-60-213, Aug. 1960

Gragg, D.B., "An Occupational Survey of the Airman Supply Warehousing-Inspection Career Ladder," Texas: Lackland Air Force Base, Personnel Research Laboratory, in press

Harding, F.D., "Survey of Airman Pay Grades in Various Career Fields," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Memorandum WCLL-TM-59-34, Oct. 1959

Harding, F.D., "Position Evaluation: Feasibility of Scaling Factor Definitions," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Memorandum WWRDP-TM-60-19, May 1960

Harding, F.D., "Ranking of AFSCs in Terms of Amount of Training and Work Experience Needed," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Memorandum WWRDP-TM-60-28, July 1960

Harding, F.D., and Madden, J.M., "Analysis of Some Aspects of the Air Force Position Evaluation System," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-60-143, July 1960

Harding, F.D., Madden, J.M., and Colson, K., "Analysis of a Job Evaluation System," J. Appl. Psychol. 44:354-357, 1960

Harding, F.D., and Naurath, D.A., "Effects of Job Experience and Organization on the Rating of Tasks," Eng. Industr. Psychol. 2:63-68, 1960

Jenkins, W.S., and Wiley, L.N., "A Task-Duty List of the Communications Officer Specialty, AFSC 3034," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Memorandum WWBP-TM-61-17, Apr. 1961

Judy, C.J., "An Analysis of Qualifications Data on a Group of Air Force Mechanics," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADC-TN-59-40, June 1959

Judy, C.J., "An Analysis of the Relationship Between Aptitudes, Education, and Job Family Assignment," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Memorandum WCLL-TM-59-25, Aug. 1959

Judy, C.J., "Relationships Between Available Qualifications Data and Initial Assignment," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADC-TN-59-200, Dec. 1959

Judy, C.J., "Appraisal of Educational Requirements for Airman Specialties," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-60-264, Dec. 1960

Judy, C.J., "A Validation of Qualification Requirements for Work in a USAF Specialty," Occup. Psychol. (London) 35:71-75 1961

Madden, J.M., "A Comparison of Three Methods of Rating-Scale Construction," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-60-262, Nov. 1960

Madden, J.M., "A Note on the Rating of Multidimensional Factors," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-60-258, Oct. 1960

Madden, J.M., "A Preliminary Effort at Identifying the Dimensions of Task Difficulty in Air Force Jobs," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Memorandum WWRDP-TM-60-18, Apr. 1960

Madden, J.M., "A Review of Some Literature on Judgment with Implications for Job Evaluation," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-60-212, Aug. 1960

Madden, J.M., "Context Effects in Job Evaluation," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-60-220, Oct. 1960

Madden, J.M., "Familiarity Effects in Evaluating Judgments," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-60-261, Nov. 1960

Madden, J.M., "A Further Note on the Familiarity Effect in Job Evaluation, Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note ASD-TN-61-47, June 1961

Madden, J.M., "A Study of Three Rating Scales for Use with Task Inventories and an Illustration of Their Application," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Memorandum WWRDP-TM-61-8, Jan. 1961

Madden, J.M., "The Methods and Foundations of Job Evaluation in the United States Air Force," (with appendix, "Annotated Bibliography of Job Evaluation," by M. Joyce Giorgia and J.M. Madden) Texas: Lackland Air Force Base, Personnel Laboratory, Technical Report ASD-TR-61-100, Oct. 1961

McCormick, E.J., "Effect of Amount of Job Information Required on Reliability of Incumbents' Check-List Reports," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-60-142, July 1960

McCormick, E.J., and Ammerman, H.L., "Development of Worker Activity Check Lists for Use in Occupational Analysis," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Report WADD-TR-60-77, July 1960

McCormick, E.J., and Tombrink, K.B., "A Comparison of Three Types of Work Activity Statements in Terms of the Consistency of Job Information Reported by Incumbents," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Report WADD-TR-60-80, Aug. 1960

McCormick, E.J., and Williams, J.R., "The Scaling of Job Activity Statements on Specificity and Related Variables," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Memorandum ASBP-TM-61-21, June 1961

Morsh, J.E., "Job Analysis Bibliography," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Memorandum WCLL-TM-58-18, Nov. 1958

Morsh, J.E., "Job Analysis Bibliography," Texas: Lackland Air Force Base, Personnel Research Laboratory, Technical Documentary Report PRL-TDR-62-2, Mar. 1962

Morsh, J.E., Madden, J.M., and Christal, R.E., "Job Analysis in the United States Air Force," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Report WADD-TR-61-113, Feb. 1961

Morsh, J.E., and Ratliff, F.R., "Occupational Classification in Some Major Government Agencies," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADC-TN-59-37, Mar. 1959

Rupe, J.C., "Research into Basic Methods and Techniques of Air Force Job Analysis - I," Texas: Lackland Air Force Base, Human Resources Research Center, Technical Report 52-16, Dec. 1952

Rupe, J.C., "Research into Basic Methods and Techniques of Air Force Job Analysis - IV," Texas: Lackland Air Force Base, Air Force Personnel and Training Research Center, Research Report AFPTRC-TN-56-51, Apr. 1956

Rupe, J.C., and Westen, R.J., "Research into Basic Methods and Techniques of Air Force Job Analysis - II," Texas: Lackland Air Force Base, Air Force Personnel and Training Research Center, Research Report AFPTRC-TN-55-51, Nov. 1955

Rupe, J.C., and Westen, R.J., "Research into Basic Methods and Techniques of Air Force Job Analysis - III," Texas: Lackland Air Force Base, Air Force Personnel and Training Research Center, Research Report AFPTRC-TN-55-53, Dec. 1955

Ward, J.H., Jr., "Hierarchical Grouping to Maximize Payoff," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADD-TN-61-29, Mar. 1961

Ward, J.H., Jr., "Multiple Linear Regression Models," in "Computer Applications in the Behavioral Sciences," H. Borko (ed.), Englewood Cliffs, N.J.: Prentice-Hall, pp. 204-237, 1962

Ward, J.H., Jr., and Hook, M.E., "A Hierarchical Grouping Procedure Applied to a Problem of Grouping Profiles," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note ASD-TN-61-55, Oct. 1961

Ward, J.H., Jr., and Hook, M.E., "Application of a Hierarchical Grouping Procedure to a Problem of Grouping Profiles," Educ. Psychol. Meas. (in press)

Wiley, L., "Determining Job Qualification Requirements by Rating Air Force Task Statements," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADC-TN-59-41, July 1959

Wiley, L.N., "Does Industry Need Task Qualifications Analysis?" Personnel Admin. 24:23-30, and 52 (1961)

Wiley, L., Harber, H.B., and Giorgia, M.J., "Evidence for a Generalized Rating Tendency," Eng. Industr. Psychol. 1:55-61 (1959)

Wiley, L., Harber, H.B., and Giorgia, M.J., "Rater Tendencies in Estimating Qualifications Required by Air Force Tasks," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Note WADC-TN-59-195, Sep. 1959

Wiley, L.N., and Jenkins, W.S., "Subject Matter Specialists Rating of the Measurability of Specialty Qualifications," Texas: Lackland Air Force Base, Personnel Laboratory, Technical Memorandum ASBP-TM-61-25, Aug. 1961

Wiley, L., and Jenkins, W.S., "A Method for Measuring Bias in Raters Who Estimate Job Qualifications," Industr. Psychol. (in press)

SUMMARY COMMENTS

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Since most personnel research workers typically are concerned with specific areas of research, it seems useful once in a while to have someone jerk us out of our circumscribed cubbyholes to survey more of the world around us. This conference on New Approaches to Personnel-Systems Research seems to be such an occasion. When we take such a look-see, however, the lack of resolution may be bothersome. While the individual pieces we may have been working on have their problems, at least their contours may seem more definable than those of the amorphous thing which is here labeled "personnel systems."

Since our chairman and his steering group wisely chose not to define what was meant by personnel systems, I will also follow this easy way out. But it must be apparent that its coverage ranges the gamut of (but is not restricted to) such well-recognized functions as personnel selection, training, personnel evaluation, job analysis, job evaluation, promotions, career ladders and systems, and manpower planning. But while we might envision the notion of personnel systems as embracing this same familiar Mulligan stew of ingredients, however, I think I have sensed, during recent years, a somewhat different flavor to the stew. The individual, and distinctive, flavors of the separate ingredients are being replaced (in part) by a blend that is somewhat different from the sum of the parts. The statisticians would tell us that this is an interaction. While my Mulligan stew analogy is not really a very good one, I think that there is, in the personnel ballpark, an increasing recognition of the problem of interaction among the various components.

Let me mention a few examples. The attention in recent years to human factors in engineering is indeed a recognition of an interaction—that of men with machines--and is concerned with adapting human work more to the capabilities and limitations of human beings. The mention, on various occasions during this conference, of job engineering reflects essentially the same interest in adapting jobs to people. Mr. Lee raised a question as to whether it is possible to tailor a total system to take into account major changes in manpower requirements over time (such as the need for aviators). This reflects concern with respect to the effects (interactions) of technological changes upon manpower planning. The research reported by Mr. Knetz illustrated the impact of personnel policy, such as duration of training, upon quantitative manpower requirements.

Without belaboring the point further, it seems to me that one can appropriately refer to the personnel system if there is full awareness of the many interactions that are intrinsic to the total assemblage. These interactions may be likened to the effects of punching a great big rubber ball; if you punch it at one place, there is some effect elsewhere.

I do not mean to imply that this interaction of the various components of the personnel system is just now being recognized, since such awareness has indeed been around for some time. I do think, however, that this recognition is gradually becoming more part and parcel of the ways in which people approach personnel problems, and that there is less vacuum-packed compartmentalization than in the days gone by.

If, then, increased recognition of interactions in personnel affairs, and increased attention thereto, can be considered as justification for talking in terms of personnel systems, one

might ask what are the new approaches to personnel systems research that the topic of this conference implies we have been talking about. I think one would be rather hard pressed to prepare a detailed list of particularly "new" approaches of major consequence - if one were constrained to point to past achievements. Even some future speculations might be a bit hard to come by. We are not accustomed in the personnel area to dramatic breakthroughs, and we might have difficulty enduring such success if ever it came about. We will probably have to remain adapted to gradual, faltering progress rather than to that of an earthshaking nature.

With respect to the gradual progress theme, however, I believe there are certain current developments that are worthy of particular note with respect to our personnel-systems frame of reference. Dr. McClelland, for example, referred to the beginnings of a technology of training. Such a technology involves consideration of total systems from the human factors point of view, the specification of skills and knowledges in terms of job and system goals, and consideration of performance standards. These various facets of such a postulated technology seem very appropriately to fit into the interaction framework of personnel systems. Mr. Abel, Mr. Knetz, and Dr. Christal spoke of computer programs which offer promise of facilitating research, and the application of the results thereof, in ways that have not previously been available. Such computer programs seem to widen the feasible horizons of personnel-systems research. The work activity inventory scheme being used by the Personnel Laboratory at Lackland AFB, and the related computer program for job clustering, seem to offer promise of providing massive job-information collection and analysis techniques which can serve a variety of purposes such as training, job engineering, organizational structuring, manning tables, etc. (As an aside, it seems in order to commend the development of tri-service moral support for such a program.)

Research activities such as those mentioned seem thoroughly compatible with the package (vs piece-meal) view of personnel systems. But it is in the nature of things that conferences such as this should be concerned not only with where we have been, but also where we are (and should be) going. The glass is indeed pretty cloudy, but taking some cues from our past failings we can perhaps derive some ideas for future guidance purposes. From this point of view, and drawing largely from what has been said (and unsaid) at this conference, it seems that an unfinished-business agenda might well include some of the items below.

1. Semantics in job analysis and description. There seems still to be some need for standardization in characterizing human work, including a more definitive crystallization of certain operational concepts, such as elements, tasks, duties, etc., and perhaps the development of standard operational meanings of certain work activity terms. (The Navy, incidentally, has made some progress in this direction, as reflected in their recent job analysis manual.)

2. Methods of collecting job information. The process of collecting job information from incumbents by the use of job activity inventories seems reasonably applicable to enlisted jobs. The collection of information relative to the more executive and supervisory types of jobs, and those involving major decision-making responsibilities, has remained a major problem in the analysis of officer positions.

3. Job evaluation. The problems associated with job evaluation (especially of officer jobs) still have not evaporated.

4. Job engineering. With information from job activity inventories and other sources potentially available, it seems that an upcoming item of major business would be that of exploring the possible utility of job engineering to personnel systems. Questions arise as to whether there are (or are not) any significant benefits to be derived by such an effort. If so, what should be the objective of such an effort? How would this affect organizational structures, training, personnel accounting, personnel assignment, the career patterns of men in the services, manpower, requirements by aptitude classification, etc.? Should the purpose of job engineering be that of grouping tasks that require similar aptitudes or related technical operations, or should such grouping be in terms of organizational processes and sequences? How much reward (if any) is there in job engineering?

5. Transferability considerations. Despite probably thousands of laboratory experiments on transfer of learning, there is as yet no adequate, tested, systematic method of determining or estimating the degree of transferability from job to job. At the risk of being redundant (having spoken about this before), it seems to me that there is no domain of human life in which transferability measures would be more useful than in the world of human work. It seems to me that there is a significant challenge to psychologists here: Can psychologists provide any systematic operational procedures for determining quantitatively the degree of transfer from job to job in the real world? And can any realistic theory be developed that relates to this problem? The military services have various problems to which such procedures would be helpful, such as the structuring of career ladders, cross-training, determining whether different jobs should or should not have separate classifications, etc.

6. Work measurement. Manpower estimates in part should take into account considerations of work measurement. It would seem that continued hammering at this would offer some promise of long-range payoff.

Aside from certain items on the unfinished-business agenda, there seem to be certain others that should be entered as new business--new in the sense that relatively little has been done in these areas as yet. Certain of these are problems which appear to be facing the military services in personnel policy and management affairs. Certain of them offer serious challenges in the form of such questions as: Can research contribute to the solution of this problem? Or must the policy maker make a decision in the absence of research information?

7. Work organization and scheduling for effective use of personnel. While effective work organization and scheduling is important under any circumstance, it is especially pertinent in the utilization of scarce skills, such as electronic technicians. The Navy's estimate that ET's are plying their trade 40 percent of the time, and performing other duties the rest of the time, probably is a dramatic example, but there undoubtedly are many other less dramatic situations. Rotation between overseas and US assignments might also affect the extent to which personnel (especially those with scarce skills) are utilized. Major changes in the organization of work could involve alterations in long-standing military personnel practices (such as the practice of all personnel spending some time at strictly "military" activities, rotation policies, the policies regarding variation in position assignment, etc.). Policy decisions have to be made, as necessity requires. It would seem that it would at least be in order to explore the possible extent to which research might be useful in connection with such problems.

8. Long-range personnel utilization of individuals. The nature of the military system is one in which changes in the nature of work assignments of individuals occur with time. Some such changes are dictated by age considerations (for example, air crews), by obsolescence of weapon systems, and other changes in military programs. Mr. Lee raised the question as to whether a personnel system could be so tailored as to take into account the shifts in manpower requirements implicit in such changes. It would seem that some systematic effort to facilitate the optimum transfer of such personnel to new types of work would be in order. Such an undertaking would seem to require, first, an analysis of the suitability of individuals to very different types of work (the suitability being in terms of transferability of previous experience to new situations, or in terms of aptitudes and other personal qualities), and second, consideration of pertinent quantitative manpower requirements.

9. Other aspects of personnel utilization. Aside from some of the topics previously mentioned, there are a number of other aspects of personnel utilization that have distinct implications of an interaction nature. The woods undoubtedly are full of these kinds of problems, but two or three will be mentioned to illustrate the type of problem in mind. For example, there may be some optimum degree of specialization which could be determined--considering the many related facets of training time, training cost, expected duration of service, constraints imposed by the need for more precise classification and assignment (in the case of more narrowly trained personnel), performance level, possible increase in supervision required, etc. In terms of certain objectives it seems wise to keep the experts in special fields assigned to positions in their fields. But such objectives are at odds with the possible desirability of developing broadly experienced people for, say, supervisory and administrative functions. Can research provide information that would bear on this? As another example, in recruit

training, the requirements for meeting school quotas come in bàtches. Considering the factors of level of qualification of individuals (especially in the case of individuals who have had civilian experience closely related to the training), of numbers of people fulfilling these requirements, of time-to-wait pending school assignment, etc., for what period of time would it be worthwhile storing men for their optimum school assignments? As still another example, the determination of an optimum balance between mechanization vs nonmechanism of certain functions conceivably could be facilitated through appropriate research. In certain circumstances for instance, the possible advantages of greater human reliability may outweigh other advantages of mechanization, or the requirement for highly skilled mechanics to maintain mechanized equipment may minimize the total utility of such equipment to the military services in question.

The availability of computer programs, and of techniques such as those of operations research, make possible the analysis of data such as would be required in such problems. The development of reliable and valid measures of the pertinent variables and the development of appropriate experimental designs, however, are serious limitations to such research endeavors.

In general, the various papers presented at this conference have covered a varied range reflecting, in a way, at least some of the specific domains which are perceived as being subsumed under the broad cloak of "personnel system." Since the most practical method of eating an elephant is by taking a bite at a time, it is probable that much of the research in personnel systems must continue to be related to specific segments of the whole. Perhaps there are, however, certain possible benefits that can accrue from talking about personnel systems even though much of our work deals with the pieces thereof. In the first place, it provides a frame of reference, or point of view, that is characterized by the concept of interactions; in the long run this might contribute toward the development of research which is more system oriented. Further, the development of a personnel-system focus might lead to the more systematic investigation of some of the interacting variables of such systems with a view toward providing more adequate bases for decision in personnel policy and management.

Office of Naval Research. Report ACR-76. TRI-SERVICE CONFERENCE ON NEW APPROACHES TO PERSONNEL-SYSTEMS RESEARCH. 80 pp., and figs. May 1962. The proceedings of an annual tri-service invitational conference are reported. Representatives of the Army, Navy, and Air Force gathered together to engage in informal discussions of personnel-systems research and to present formal reports of recent relevant research. The formal reports are contained herein. They cover recent changes in the U.S. Employment Services classification system which promise to have important implications for all military service personnel systems. A number of specific research efforts emphasizing new approaches are reported along with generalized overviews of personnel-systems research in each of the three major military services.	1. Military personnel – Selection 2. Conferences 3. Job Analysis	Office of Naval Research. Report ACR-76. TRI-SERVICE CONFERENCE ON NEW APPROACHES TO PERSONNEL-SYSTEMS RESEARCH. 80 pp., and figs. May 1962. The proceedings of an annual tri-service invitational conference are reported. Representatives of the Army, Navy, and Air Force gathered together to engage in informal discussions of personnel-systems research and to present formal reports of recent relevant research. The formal reports are contained herein. They cover recent changes in the U.S. Employment Services classification system which promise to have important implications for all military service personnel systems. A number of specific research efforts emphasizing new approaches are reported along with generalized overviews of personnel-systems research in each of the three major military services.	1. Military personnel – Selection 2. Conferences 3. Job Analysis
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